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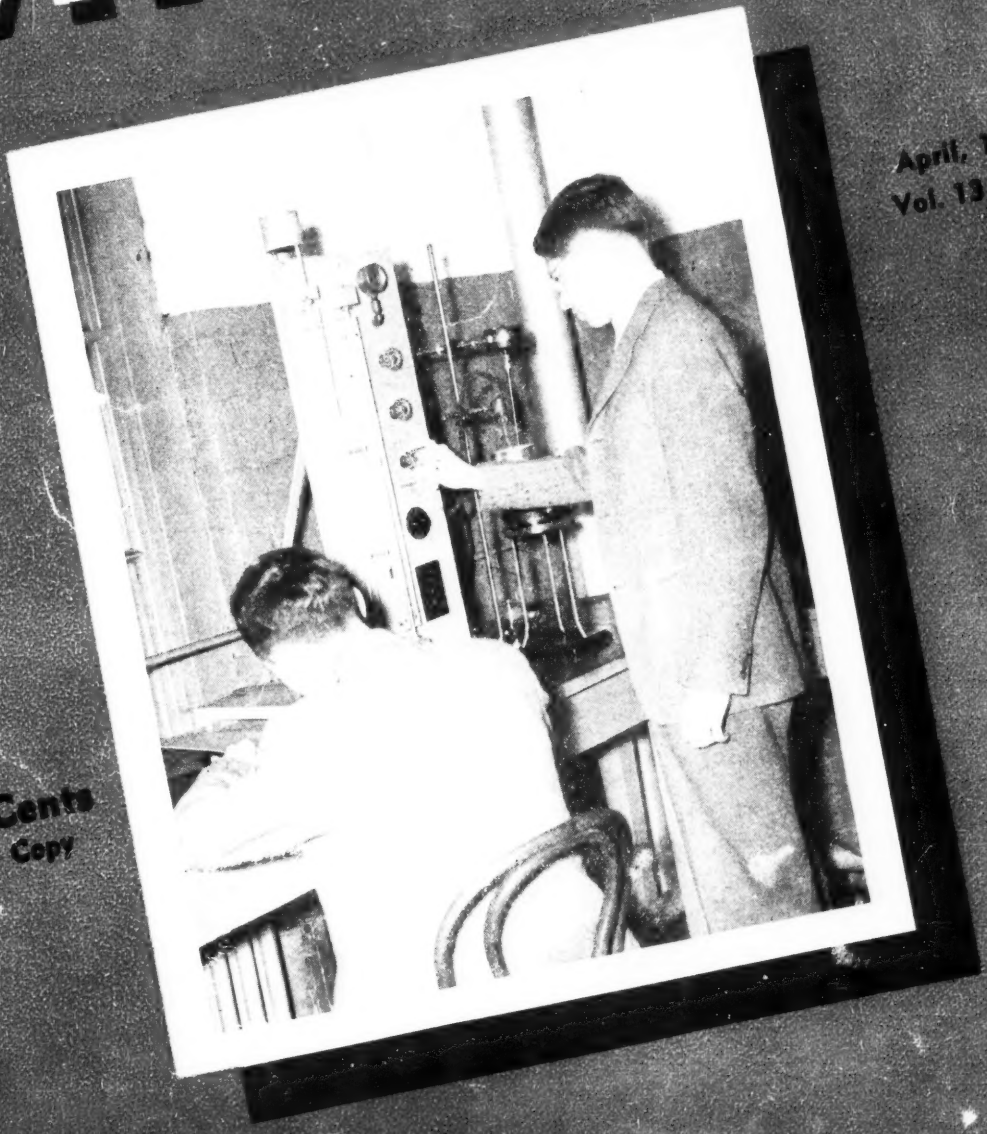

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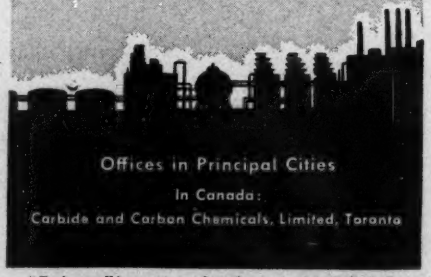

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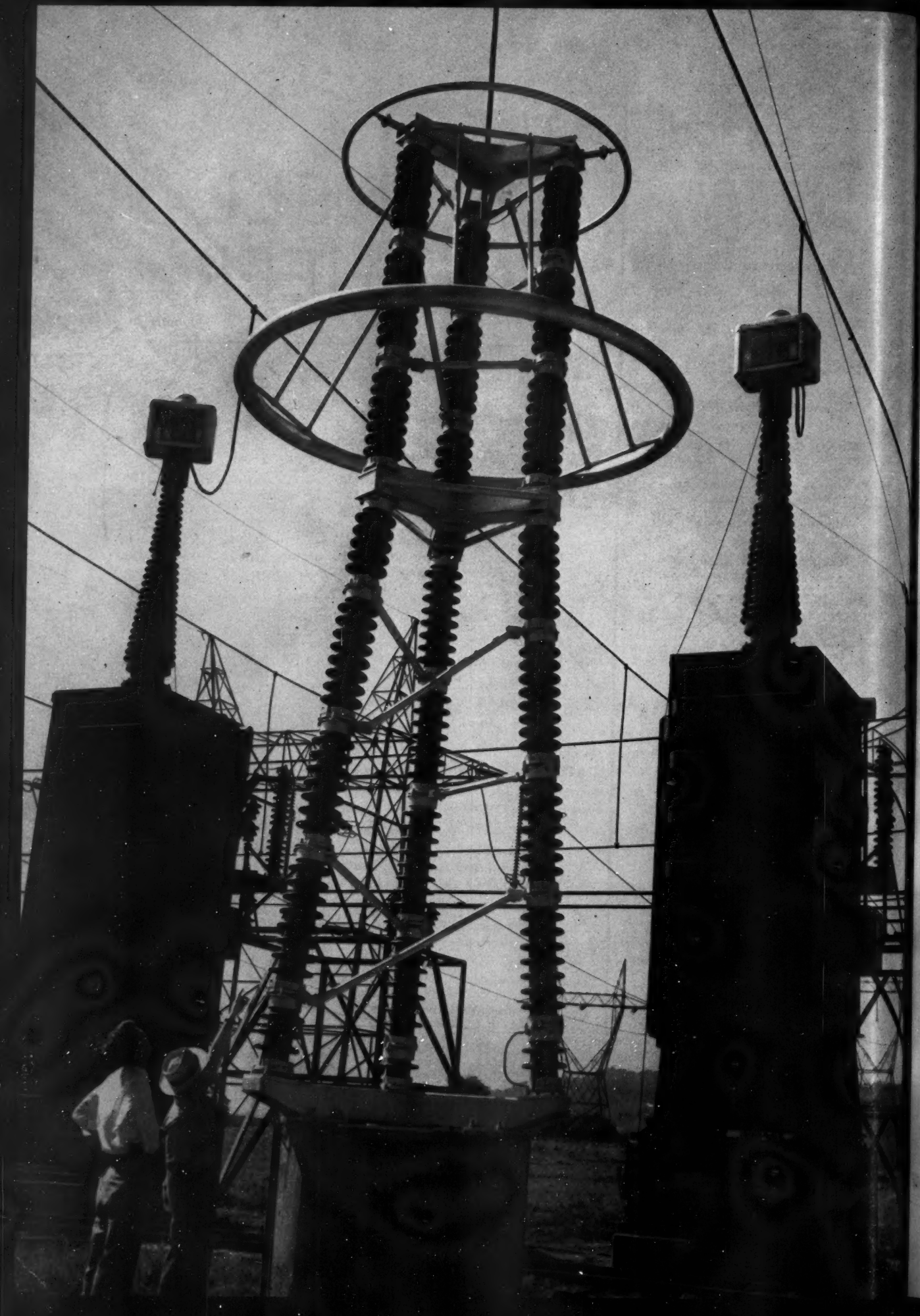

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Advances In Cable Sheathing

By OLIVER E. BUCKLEY, Ph.D. '14

THE work of Bell Telephone Laboratories is frequently regarded by those not intimate with it as being almost wholly electrical in character. Although the electrical arts, and particularly those of electronics and complex switching circuits, do occupy a prominent place in the Laboratories' program, the mechanical, metallurgical and chemical arts are also essential and play a much larger part in telephone research and development than is generally realized.

It has seemed to me that readers of the CORNELL ENGINEER, since they represent all departments of engineering, might take particular interest in a recent development which is not exclusively electrical but is based upon studies in several departments. I have selected the development of a substitute for lead and lead-alloys as sheathing material for telephone cables.

As frequently happens, when a substitute is sought, the new product is not the exact equivalent of the old, but along with certain advantages may have a few characteristics that tend to count against it. Under such circumstances—and this is true of the new cable sheath—it should be borne in mind that a considerable period of actual service must be observed before a final answer becomes available.

In many respects, lead is an ideal sheathing material. It is impervious to moisture when intact, is flexible, is readily applied by extrusion processes, and, over a period of years, has usually been low in price. But Bell System lead requirements for cable sheath in recent years have become very great, as much as 120,000 tons of lead having been used in a single year.

Lead Alloys Developed

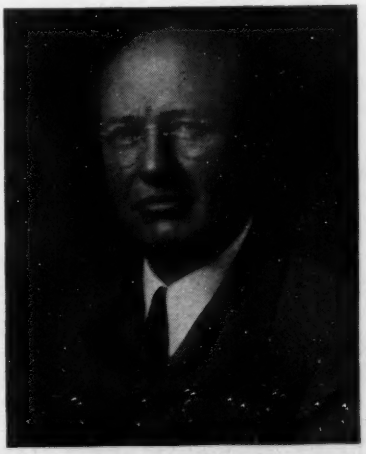
Bell Telephone Laboratories' metallurgists and cable engineers have directed much effort to the improvement of lead sheath by developing alloys of lead with other metals such as antimony, calcium, or silver to obtain better physical properties. This work, together with that of Western Electric engineers who have studied extrusion problems and of telephone engineers responsible for cable installation practices, has been effective in increasing substantially the serviceability of lead covered cables.

A lead sheath, however, offers only a single barrier against the hazards to which cables are subjected in service. If holes develop in the sheath as a result of fatigue, abrasion, or corrosion, the cable fails electrically when water penetrates. To prevent such failure and facilitate location of the break, long distance cables are usually maintained under a continuous internal gas pressure of about 9 pounds per square inch. It is still necessary, however, to make repairs when the sheath fails and the availability of

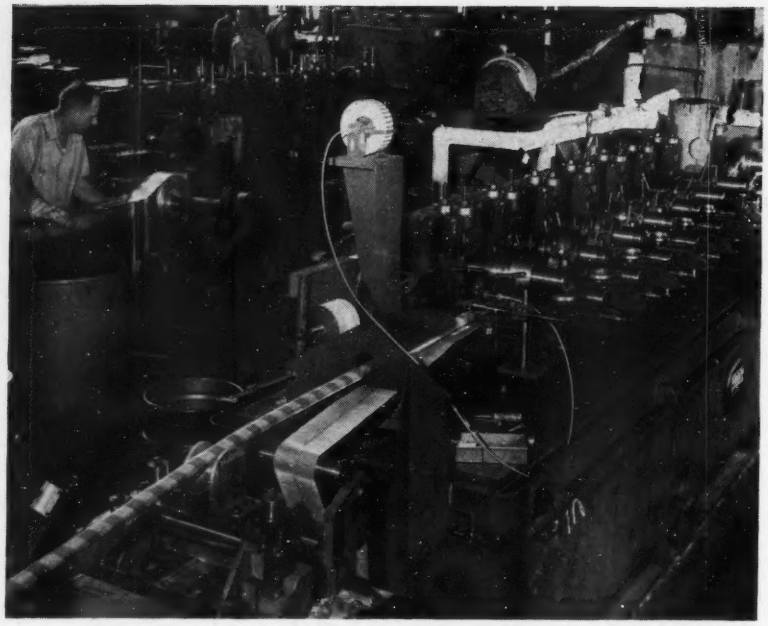
Full scale equipment presently being used for power transmission tests. The transformers pictured here have a bank rating of five thousand kva and measure thirty-three feet from the bottom of the tank to the top of the bushing. *Courtesy General Electric Co.*

THE AUTHOR

Oliver E. Buckley, President of Bell Telephone Laboratories, graduated from Grinnell College in Iowa in 1909, and in 1914 received his Ph.D. from Cornell. He then entered the Engineering Department of the Western Electric Company, now Bell Telephone Laboratories, as a research physicist. During World War I, Dr. Buckley held a commission as Major in the Signal Corps, and had charge of the Research Section of that service in Paris. Returning to the Laboratories at the conclusion of the war, he became Director of Research in 1933, and President in 1940. At the end of World War II, he was awarded the Medal for Merit for his activity in a number of national projects. The degree of Doctor of Science was conferred upon him by Grinnell College in 1936. He is a member of the Engineering College Council of Cornell University.



Oliver E. Buckley



A view of the Western Electric cable plant where Alpeth (aluminum-polyethylene) cable is manufactured. The polyethylene covering was instituted when shortages of sheathing lead arose in 1946.

—Courtesy Western Electric Co.

greatly improved lead alloys did not write the problem of cable sheath off our books.

In the hope of obtaining a sheath at least as reliable as lead, and at the same time freeing the Bell System from complete dependence upon lead when it is scarce or very high in price, a long-range study of alternative sheathing materials and processes was undertaken some years ago.

This work might have been directed toward the substitution of a single layer of some other metal for lead. The Germans, for example, investigated extruded or formed aluminum for the purpose and the English have made small cables with welded stainless steel sheaths. It seemed preferable to the Bell System cable engineers to develop a composite sheath consisting of two or more layers, each layer having its own function and yet reinforcing and supporting the others.

Early experimental work led to the design and manufacture before the war of a trial length of cable having a three-layer sheath. The inner layer was made of a thin sheet of tinned steel, corrugated transversely for flexibility, folded around the cable core in a continuous operation, the overlapping seam being sealed with an adhesive compound. Over the inner sheath a layer of rubber thermoplastic compound was applied. This material was chosen for its resistance to moisture penetration and its low cost. It was applied in the form of a continuous longitudinal tape, the edges being trimmed by circular cutters which pinched them together. Over the plastic layer a corrugated sheath of tinned brass was applied. In the case of the outer sheath, the overlap was soldered in a continuous operation. Floodings of adhesive compound were used over the inner steel sheath and over the plastic compound.

A length of this cable was installed aerially at our Outside Plant field laboratory at Chester, New Jersey. A length was also placed on a test line where it was swung back and forth to accelerate the fatiguing and abrasive actions to which aerial cables are subject. Samples of somewhat different construction but having a brass sheath in combination with other elements were buried directly in the ground at about the same time.

During the war, development work on the project was suspended. But in 1945, after the termination of hostilities, the aerial cable at Chester was made the subject of careful examination. Measurements of insulation resistance proved that moisture had been excluded over the eight-year trial period. Moreover, the entire sheath proved to be in good condition, except that microscopic examination disclosed evidence of corrosion along the soldered seam of the outer brass covering. This was determined by the metallurgists as being due to the formation of speculum metal, a solid solution (epsilon phase) of copper and tin. This material is relatively noble and electrolytic corrosion results in adjacent metals to which it is coupled, i.e., in the copper in the brass sheath or the zinc galvanizing on supporting steel strand or associated hardware. Further metallurgical study developed a method for applying a coating of lead to the brass to serve as an anti-corrosion protection to be used on future brass sheaths.

In view of the generally excellent performance of the experimental cable, it was agreed to proceed with the development of brass sheath, on a limited basis involving small commercial production. Just at that time, however, a new factor entered the picture, the lead supply becoming very critical indeed. It was therefore decided to accelerate and expand the composite sheath program.

War Plastic Suggested

The physical requirements for composite sheath suggested exploration of an outstanding plastic which had come into quantity production during the war, viz. polyethylene, a thermoplastic. Its excellent electrical properties had led to its use as early as 1941 for insulation of the coaxials in the Baltimore-Washington coaxial cable. Moreover, during the war, polyethylene was used in flexible microwave cables, both as primary insulation and for jacketing certain cables.

Its electrical properties, with the possible exception of dielectric strength, are of little consequence in cable sheath, but it happens that its mechanical properties are very well adapted to the purpose. All organic materials permit diffusion of water vapor to some degree, but

(*Continued on page 28*)

History of Science —A Recapitulation

By KATHARINE R. WEIDMAN, Arts '48

THE attention of Cornellians was focused on the University's History of Science collection this winter by the exhibit in the main library of some of the rare volumes in the collection. On display were fifty books outlining the highlights of the history of two phases of astronomy—comets and physical astronomy, telling of the superstitions once surrounding the natural phenomena of the skies and the gradual development of scientific knowledge and insight into the physical laws governing the motions of heavenly bodies. It is interesting to note in these volumes the conflicting theories between theologians and scientists, and among scientists themselves, and the beliefs of the laymen, which were generally influenced more by superstitions than by facts based on scientific observation and deduction.

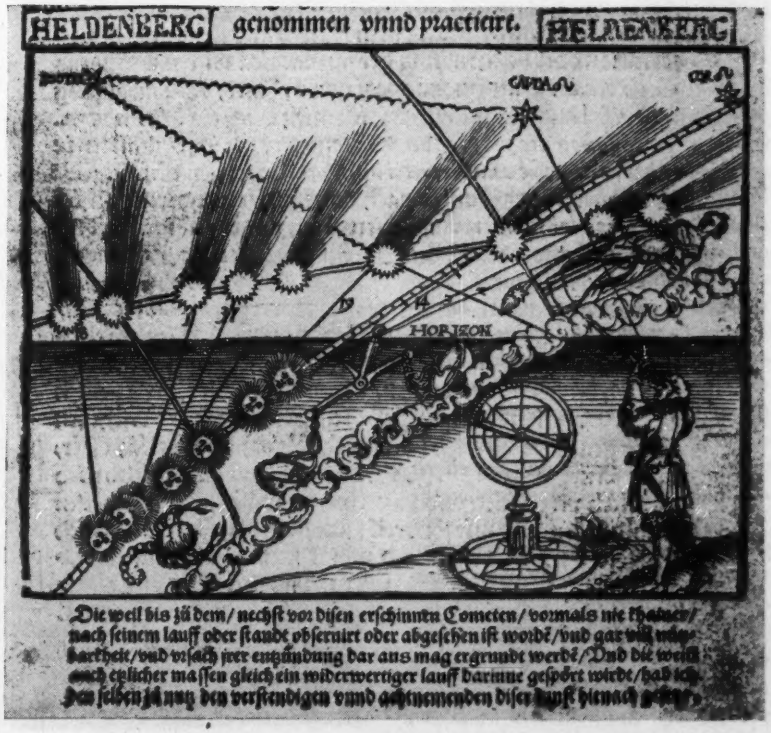
Portentous Comets

Throughout the Middle Ages the appearance of comets struck terror in the observer's heart, and caused speculation as to the nature of the disaster these fiery bodies portended. The great comet of the eleventh century, duly recorded on the Bayeux tapestry, was believed in later centuries to have signalized the death of Edward the Confessor and the Norman Conquest of England. This tapestry is the earliest portrayal of Halley's comet. A catalogue of famous comets and the human events they supposedly presaged, is included in Antoine Mizauld's *Cometographia*, written during the Renaissance when belief in the pseudo-sciences flourished.

One of the many astronomers who sought to gain a natural explanation for the appearance and behavior of comets was Tycho Brahe, whose observations of the great comet of 1577 were duly recorded by him in one of the classics of the history of astronomy. In this treatise, the Dane reports his discovery that the comet was not an atmospheric or terrestrial phenomenon, but moved in an orbit about the sun, and was at least several times as remote as the moon. The earliest scientific study of a comet was performed by Michael Maestlin, a Protestant deacon, who became Professor of Astronomy at Heidelberg. His important treatise appeared in 1578, ten years before Brahe's more famous study, and clearly showed the supralunar position of the comet and the regularity of its motion.

While scientists explored the behavior of comets, others attacked the superstitions which had to be disqualified before the new theories

From the *Cometographia* of Antoine Mizauld, Paris, 1549. The observer in the lower corner is taking the angular distance between the two stars by means of a cross-staff. Nine successive positions of a comet are indicated, six of them above the ecliptic.



Special thanks are due Professor Henry E. Guerlac for his generous assistance in compiling the material for this article.

could be widely accepted. Even in the ministry there were those who attacked cometary superstition. The earliest systematic attempt to question the theological significance of comets as portents of evil appeared in 1578. In this year Thomas Erastus, learned physician and theologian, asserted in his tract that there could be no causal connection between comet and pestilence. Dudith, a Hungarian, argued logically in his treatise inspired also by the comet of 1577, that if comets were caused by the sins of mortals, they would never be absent from the sky. The most famous and influential attack on cometary superstition was Pierre Bayle's widely-read *Pensees diverses* on the comet of 1680, in which he declared that comets were bodies subject to the ordinary law of nature rather than prodigies amenable to no law. He showed that there was no historical evidence that comets had ever been true portents of earthly evil.

However, many still refused to discard ageold beliefs, labeling the opinions "atheistic" of those like Bayle, who attempted to disprove traditional theories. Even toward the end of the seventeenth century, in the time of Newton, Halley, and Bernoulli, ecclesiastical writers continued their attack on the new secular theory of comets. In his treatise, Father Augustin de Angelis, rector of the Clementine College at Rome, defended the Aristotelian view that comets were originated in the earth's atmosphere below the moon. He supported Aristotle's hypothesis that the motions of comets are uncertain, that they are moved by specially designated angels, and that they presage drought, earthquakes, tempests, famine, pestilence, and war. The ecclesiastical view of comets was popularized for school-children and peasants in the doggeral rhymes of two pastors, written to explain the greater comet of 1618. Increase Mather, in the American colonies, defended the portentious significance of comets in sermons and his *Discourse Concerning Comets*. (1683).

In spite of these attacks, scientific study of comets was making progress. Bernoulli, (1645-1708), professor of mathematics at Basel, proposed that comets move in parabolic paths rather than straight lines. This still assumed that comets made only single appearances. In his *Principia* (1687) Isaac Newton proved that if comets were subject to the principle of universal gravitation, and were attracted to the sun according to the inverse square law, the path must be a conic section: either a parabola, a hyperbola, or an elongated ellipse. The notion that comets might move in closed paths, returning periodically to the neighborhood of the earth, was suggested by Robert Hooke in a lecture at Gresham College in 1665. If a comet followed a closed path, then Newton's conclusions suggested that it could only describe an elongated ellipse.

Halley Calculated Orbits

The contribution of Edmund Halley to astronomical advancement is not the discovery of the comet named after him, but rather the far greater discovery of its periodic character. In 1704, Halley calculated orbits for the twenty-four comets that had been well observed up to his time. To his astonishment, he found that among his calculated orbits, three were almost identical, those for 1531, 1607, and 1682. Assuming that these represented appearances of the same comet, he correctly predicted its return about 1758. The results of this research were published in his *Astronomiae Cometicae Synopsis* which appeared in the Philosophical Transactions for 1705.

From Cornell's copy of the first edition of Galileo's great *Dialogue on the Two Systems of the World*. The figures are supposed to represent Aristotle, Ptolemy and Copernicus. The dates above the figures are in the hand of President Andrew D. White, who mistook the representation of Aristotle for a portrait of Galileo.

In the field of physical astronomy, men supported and challenged old beliefs, and proposed new theories. The most popular astronomical textbook of the Middle Ages was the *Sphaera Mundi* written about 1256 by the Yorkshireman and Oxford scholar, Johannes de Sacrobosco. Intending his *Theorica Planetarium* of 1515 to be a supplement to Sacrobosco, George Purbach's discourse was rather an exposition of Ptolemaic theory. Astronomers of the fifteenth and sixteenth century attempted to comprehend the great storehouse of Greek mathematical astronomy, Claudius Ptolemy's *Syntaxis* or *Almagest*. Purbach, in his book, tried to reconcile the materialistic scheme of cystalline spheres of Aristotle, whose naive ideas dominated the Middle Ages, with the more mathematical views of Ptolemy.

Another Renaissance author, Petrus Apianus, not only wrote voluminously on astronomy and geography, but also designed many improved astronomical instruments which he described in his *Folium Populi*. His masterpiece, *Cosmographicus Liber* (1524), a great pioneer work on geography, explains how to determine latitude from the meridian altitude of the sun, and suggests the method of lunar eclipses to determine longitude.

Perhaps the most talked of, and least read, classic of the history of science is Copernicus' profound work, *De Revolutionibus Orbium Coelestium Libri VI*, in which he presents the theory that the earth and other planets revolve around the sun as a center. Early resistance to this heliocentric doctrine resulted from both scientific and theological conservatism. After wide currency had been given the views of Copernicus by Bruno and Galileo, his work was placed on the *Index Librorum Prohibitorum* by the church in 1616, and was not removed from the *Index* until 1835. Galileo, in his celebrated *Dialogue on the Two Chief Systems of the World*, puts forward a veiled, but

powerful plea for the superiority of the Copernican position over the Aristotelian-Ptolemaic cosmology. Since this support of Copernicus violated the decree of 1616, the *Dialogue* led to the trial of Galileo before the Inquisition of Rome.

Rockets Anticipated

In England, Galileo's views were popularized by John Wilkins, one of the founders and original fellows of the Royal Society of London, who wrote in 1638 a scientific fantasy, *The Discovery of a World in the Moon.* To a later edition he added an appendix entitled, *Discourse on the Possibility of a Passage Thither.* Wilkins anticipates modern speculations concerning spaceships and rocket travel by suggesting the possibility that a body could be propelled with sufficient force to carry it beyond the earth's "sphere of gravitie." Before Newton, Wilkins popularized the idea of universal gravitation.

Building on the dynamical discoveries of Galileo, Newton laid the foundations of classical physics in his great *Mathematical Principles of Natural Philosophy* (1687). From his fundamental laws of motion, and the famous inverse square law of universal gravitation, he was able to demonstrate that planets were held in their orbits about the sun by the same agency which caused lesser bodies to fall to earth.

This describes a few of the books from Cornell's History of Science exhibit, and implies the importance of their position in astronomical history. The exhibit was arranged by Professor Henry Guerlac of the History Department, whose History of Science course was first added to the curriculum in the Fall Term of 1946.

The frontispiece of the 1515 edition of Purbach's *Theorica Planetarium*. The figures representing Astrology and the astronomer Ptolemy are shown beneath a large armillary sphere, a geometric model of the universe.

Science Library Nucleus

Due almost entirely to the interest in the early history of science by Andrew D. White, the first president of Cornell, and his acquisitions in this field, the University has a fine nucleus for a growing History of Science Library. Professor George L. Burr, who was one of the most distinguished members of Cornell's Department of History, aided White in purchasing rare volumes as reference material for his famous book, *History of the Warfare of Science with Theology.* (One of the most valuable of these volumes, the now almost unobtainable first edition of *De Revolutionibus Orbium Coelestium Libri VI* by Copernicus, was purchased by White for less than thirty dollars, and is now worth more than thirty times this price.) A member of the U.S. State Assembly and friend of White, Hon. William Kelly presented to Cornell in 1870 his valuable library on the history of physical sciences. It is hoped that Cornell's History of Science Library, which is just now developing, will gain as much fame as the University's Dante, Petrarch, and Icelandic collections. Because of Cornell's excellent engineering school and emphasis on applied sciences, it is exceedingly worthwhile and appropriate that volumes on the early history of science and engineering development be here assembled and treasured. With the acquisition of more of these rare volumes, Cornell will be able to build a renowned and complete History of Science library.

A FIELD LONG NEGLECTED BY TECHNOLOGICAL ADVANCES

Streamlining Reaches the Foundry

By WILLIAM M. McQUILLEN, ME '47

Photographs Courtesy National Engineering Co.

EDITOR'S NOTE:

The author has here presented a few of the more salient improvements in foundry layout and equipment. Cornell's recently instituted curriculum in metallurgical engineering is now training young men to enter the foundry industry, a field in which a noteworthy interest is being exhibited by young engineers.

IT seems odd, that in an era such as ours, which has been characterized by multiple scientific discoveries, and even greater strides in the development of the physical sciences, that one of our largest and most basic industries has lagged far behind. I am speaking of the foundry industry. It has been only in the past twenty-five years, that engineers and designers have turned their attention toward the foundry industry with its many undeveloped potentialities.

Unfortunately, the percentage of foundries which have had the foresight to mechanize has been small, and the vast majority of shops still employ methods and equipment which are obsolete and primitive. These outmoded plants will have little chance to compete with more mechanized foundries in the light of increasing demands for the mass production of low cost, high quality castings. The remainder of this discussion will be concerned chiefly with those of the more recent developments and improvements in foundry methods and equipment.

(1) *Metallurgical Advancements*

While there has been some tendency on the part of the "dyed in wool" foundrymen to scoff at the highly technical field of theoretical metallurgy, there can be no questioning the fact that this science has led to many developments in practical metallurgy, which have resulted in metals which are superior in both composition and structure. It is interesting to note the significance of proper structure as a requisite to good casting design. Destructive testing of two castings with identical chemical composition, but with widely different metallographic structures, has shown that certain desirable structures for specific applications may as much as double the working life of that cast machine part.

Great advances have also been made in improving the melting procedure and increasing the control of composition. The "by guess and by gosh" methods of cupola metallurgy which were prevalent just a few years ago, are rapidly being replaced by superior techniques and more accurate control equipment. In our own plant procedure, every charging ingredient is carefully analyzed by an industrial metallurgist prior to the establishment of our charging ratios. This insures a more accurate control of the composition of the metal at the cupola spout. Again, after the metal has been cast, test drillings are taken and analyzed to check final composition. In addition, photomicrographs are taken to determine the type of structure present.

Experimental industrial metallurgy has also provided the practical foundryman with a wide variety of high quality alloys and ladle innoculants. Ferro-manganese, ferro-silicon, ferro-chrome, molybdenum, and carbonates, are but a few of the addition agents available to the modern foundryman.

Production in the pouring zone is greatly facilitated by the mono-rail locomotive type conveyor shown here. Note that the plant is well lighted even without the modern fluorescent units hanging from the roof.

(2) *Foundry Layout and Design*

An excellent example of the modern trend in foundry layout is afforded by a grey iron foundry, built very recently in the Chicago area. This plant combines a modern, practical, and flexible design, with working conditions which will compare favorably with other industries in the locality.

A few of its advantageous design factors are listed below.

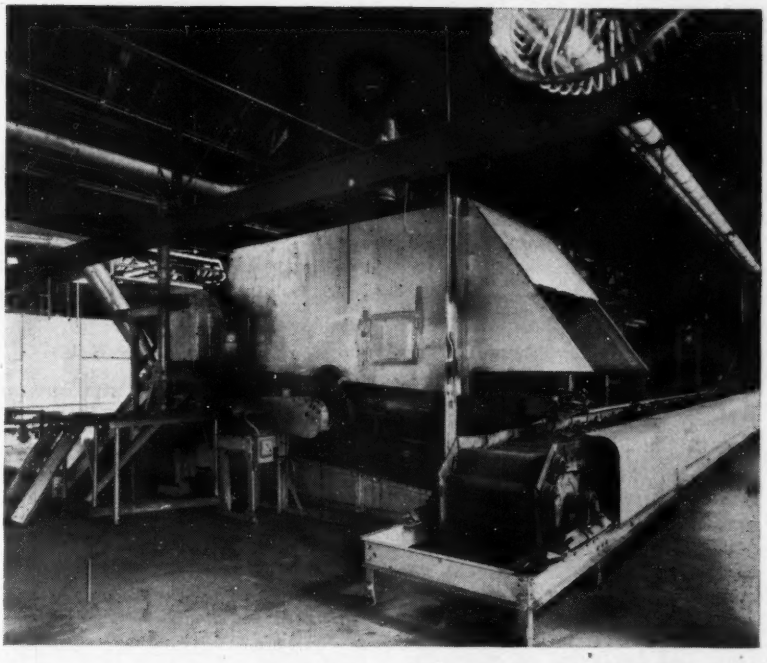
(1) Modern, beautiful, one story building, with surrounding landscaping.

(2) Only four steel supporting columns in a total of 21,600 sq. ft. of floor space.

(3) Cupola metal distributed in 600 lb. capacity covered ladles over a two line monorail system.

(4) Large capacity ventilating system to carry away gases and reduce dust count.

(5) Allowance has been made for further enlargement of the plant in future expansion.



The shakeout machine in the center of this picture is a far cry from the old method of shaking out the molds by hand. The machine is delivering castings to the conveyor at right.

THE AUTHOR

William M. McQuillen

William M. McQuillin attended the School of Mechanical Engineering, which he entered in February, 1943. At Cornell he was a member of Delta Chi. In June, 1946 Mr. McQuillin began work as a machine designer for the Tube Manifold Corporation of Buffalo. Subsequently at the Standard Buffalo Foundry, he first held the position of design engineer, and is now Assistant to the President.

(6) Direct, non-interfering traffic lines for individual departments.

(7) Window design features maximum utilization of natural lighting in conjunction with ample artificial lighting.

(8) Excellent storage facilities near point of eventual use.

(9) Modern, well-heated, well-lighted offices.

(10) Many employee conveniences such as separate lockers, showers, sanitary toilets, clean lunch room, and fan-ventilated clothes drying cabinets.

It seems at last that the "barn" type, smoke-filled foundry with its criss-crossed lines of production traffic, is on the way out.

(3) *Molding and Shakeout*

It is common knowledge among foundry cost men that the "molding direct labor cost" together with the "shakeout labor cost" represents a sizeable percentage of the "total labor cost" of a casting. From this it is axiomatic that the greatest reductions in the labor cost per casting can be achieved through mechanization (and therefore, reduced labor costs) and re-rigging in these two major departments.

In the past few years, the producers of automatic molding equipment have developed faster, safer, more accurate equipment, which has greatly eliminated the back-breaking labor in the molding process. An excellent example of the latest in automatic molding equipment is the jar-squeeze, rollover pattern-draw machine, produced by one of the large manufacturers of foundry equipment. Some of its modern features are:

(1) Control buttons arranged in sequence of use, with one button for each operating cycle.

(2) Jarring is push button controlled from start to finish.

(3) Squeeze and pattern-draw operations are electrically controlled and squeeze pressure is held constant at a predetermined value.

(4) Molds produced are of consistent and uniform structure.

(5) Scrap due to operator error is practically eliminated.

Such machines as this with their built-in "electric brains" are a far cry from the crude, hand-operated molding machines which made their first appearance at the beginning of the century.

In the shakeout department, equipment and techniques have

(*Continued on page 34*)

SHE NEITHER WALKS
NOR TALKS, BUT . . .

The Literate Doll

By VICTOR K. PARÉ, EP '51

Photographs Courtesy of the Franklin Institute

THERE is a large glass case in a hallway of the Franklin Institute in Philadelphia which always draws a crowd of interested onlookers, but which at first sight appears to contain nothing more interesting than a two-foot-high doll seated at a desk. She is a pretty doll to be sure, wearing a black dress and bonnet, holding a pen in her hand, and displaying an expression of brightness and confidence on her face, but she does not seem to fit in with the humming and clicking scientific exhibits around her. Perhaps she belongs in an art museum or in the home of a collector of artistic curiosities, but certainly not next to the Hall of Prime Movers, a room full of turbines, pumps, and models of powerhouses.

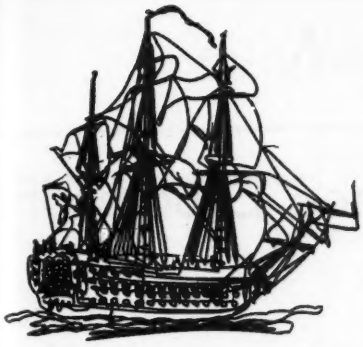
An explanation of her seemingly inappropriate presence is not long in coming, however. An elderly gentleman in the uniform of an Institute guide walks over to the glass enclosure, opens it, and touches something in the side of the finely decorated case on which the doll and her desk rest. To the amazement of some and the fascination of all, the doll, who has been sitting bolt upright, tilts her head forward, lowers her eyelids as if to look at the desk, touches her pen to a sheet of paper, and begins to draw. Her right hand moves quickly and surely, and in a few minutes she has completed a better picture of a nineteenth-century sailing vessel than most people could draw. She does not draw continuously, but stops momentarily two or three times to lift her pen from the paper and raise her eyes as if thinking what she should draw next.

A full view of the automaton resting on its decorated case. Table, case, and doll together stand about four feet high. The small door on the left side of the case opens to the end of the indexing drum.

Bilingual Poetess

Her work is by no means limited to one drawing, for in all she can draw four different pictures and write three verses, two in French and one in English. Indeed the wonderful accomplishments of the little doll have led a number of people to study it further, and the results of these investigations are as fascinating as the doll itself, from both the historical and mechanical standpoints.

When the Franklin Institute received the automaton some years ago, it consisted only of a blackened assemblage of cams, levers, and gears which had lately been through a fire in the home of its owner, a Philadelphian. It had not operated for many years before the fire, and there was little evidence to show what it was intended to accomplish. Officials of the Institute were interested in the mechanism, however, and they decided to try to rebuild it. A mechanic, Charles Roberts, took over the job and worked on it for two years, restoring it to excellent working condition. Roberts must have been a superb mechanic



This reproduction, about one-half actual size, shows how much the doll can draw in a minute or two.

to do this, for the works are very complicated and he had at first little idea what it was suposed to do. Certainly he was justified in considering its reconstruction his greatest achievement. Unfortunately it was also his last; he was drowned on a fishing trip two months after its completion.

When the automaton was given to the Institute, the donor said that it was the work of Malzel, the inventor of the metronome, but when the machine began to operate it wrote at the bottom of one of its verses "Fait par l'automate Maillardet." The name Maillardet opens a large new field for the historical researcher, for this family produced a number of great French mechanics of some 150 years ago. It may seem difficult to imagine what opportunity a man had in the eighteenth century to become skilled in the design and construction of complicated mechanisms, but it must be remembered that clocks and watches, which were fairly common in those days, provided a small but excellent field for exercise of mechanical aptitude. Since they offered the only outlet for ability of that nature, a good mechanic usually found his way into clockmaking. The best men in this profession—and there were some great ones—apparently found that making clocks which merely kept time was not interesting enough, so they began to make clocks with complicated chimes, artificial birds to sing out the time, dials showing the seasons, and even small but lifelike human and animal figures.

It is not surprising that some of these mechanics turned, in their desire for achievement, to the construction of automatons like the one in the Franklin Institute. In fact, the Maillardet writer is by no means the best of those that were built. Probably the greatest automaton-makers were Pierre and Henri Louis Jacquet-Droz, father and son. Pierre was born in 1721 and his son in 1752, and both showed great talent even as children. Pierre devoted himself to making artistic clocks until his son joined him, when the two began to make writing and drawing automatons. There were joined by a friend named Leschot, and apparently expanded automaton-making into a thriving business. They employed other great mechanics to help in the work, notably Henry Maillardet, who became head of their London branch, and also the maker of the writer on display in the Franklin Institute.

Jacquet-Droz and his son amazed and delighted the courts of Europe with their masterpieces, of which one wrote, one played musical instruments, and one sketched portraits of kings and queens. The Jacquet-Droz writers were distinguished from the Maillardet writer by the fact that they could write any sentence at all, if properly preset. The Maillardet writer has a repertoire of seven pieces of work, and will write nothing else without being completely reconstructed. The work of the Jacquet-Droz automatons was also finer than that of the Maillardet machine. The reasons for these differences will become apparent in the discussion of the mechanisms of the writers.

Mechanical Requirements

The principal part of any writing or drawing automaton is, of course, that which initiates and controls the movements of the right hand. The other bodily movements that contribute to realism can be simulated without much difficulty, for they need not be accurate. On the other hand, the motions of writing or drawing must be very closely controlled if the work produced is to be worthwhile or even readable. It is also necessary that this control be

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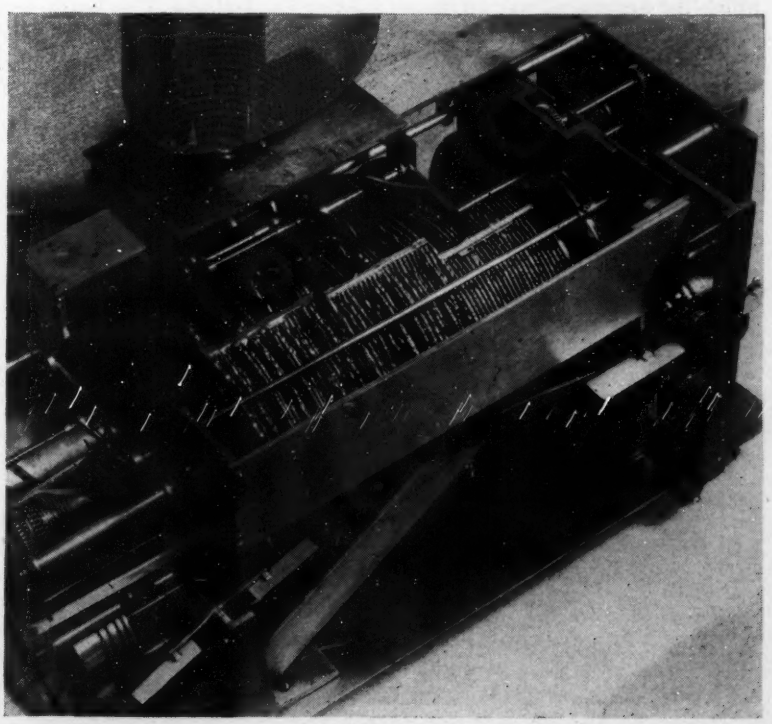
The frame of the doll can be seen supported over the complicated mechanism which enables her to write. Three groups of cams are prominent in the center, set off by the transverse bars on which the cam followers are resting.

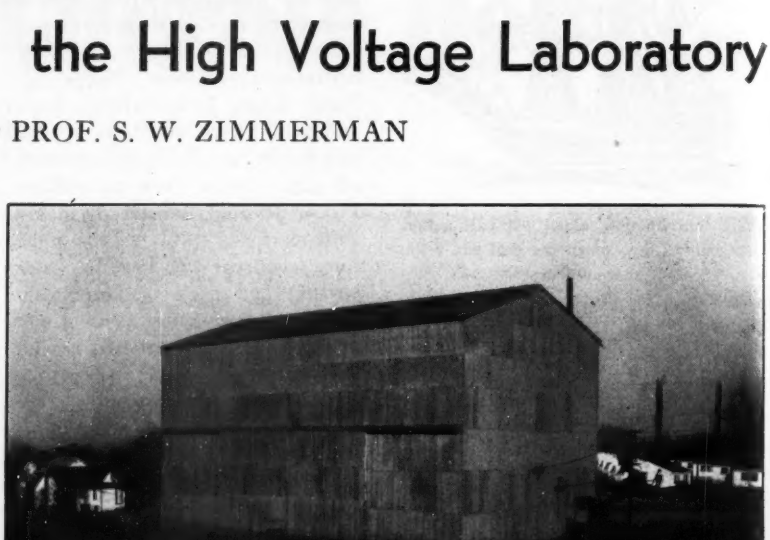


WHAT CAN HAPPEN TO A MILLION DOLLARS IN FIVE HOURS

Report on the Destruction of the High Voltage Laboratory

By PROF. S. W. ZIMMERMAN

ON the evening of Thursday, February 12, 1948, a fire of undetermined origin broke out in the southeast corner of the High Voltage Research Laboratory of the School of Electrical Engineering. This laboratory, previously described in the ENGINEER (1,2), was one of the outstanding University High Voltage Laboratories in the United States. Fire gained rapid progress and was not detected until the whole southeast corner of the building was enveloped in flames. This area of the building was used for a machine shop. Work having ceased at four-thirty and last inspection having been made about five P.M., the laboratory was not at this time under the surveillance of watchmen or laboratory personnel.



BEFORE the fire of February 12, Cornell's High Voltage laboratory was a 120 by 70-foot sheet steel structure with a height of 60 feet.

The almost unbelievable speed at which the fire spread was attributable to the inflammable character of the thermal insulation board lining the building. This board, approximately one inch thick, was not considered hazardous. The fire gained sufficient headway so that upon arrival of fire fighting equipment it was evident that the condition was uncontrollable.

. . . AND AFTER five hours of subjection to a transformer-oil fed halocaust, there remained only a mass of expensive rubble.

Those in charge entered the building and discovered the stairway to the spectator's deck was a mass of flames. The interior of the large test room containing invaluable high voltage testing equipment was filled with dense smoke. The cracking of flames overhead and the tapping of falling pieces of insulating board on the spectator's deck overhead became increasingly loud. The main laboratory room was filled with smoke so dense that the fire action could not be seen from the glass-faced control room.

Attempts were made to rescue valuable cathode-ray equipment but only the high voltage supply of one

(*Continued on page* 40)

1. R. W. Ager, CORNELL ENGINEER, Vol. 7, No. 8, May 1942.
2. S. W. Zimmerman, CORNELL ENGINEER, Vol. 11, No. 7, April 1946.

News of the College

Attends Yale Celebration

Dr. S. C. Hollister, Dean of the College of Engineering and former University vice-president, recently attended the celebration of the Centennial Year of Sheffield Scientific School at Yale University. Named by President Edmund E. Day, Dean Hollister represented Cornell at the convocation held October 17th. The celebration included a series of scientific lectures and special exhibitions.

Navy Commends Dr. Smith

The U. S. Navy Bureau of Ships has presented to Dr. Lloyd P. Smith, director of the Department of Physics, a certificate of commendation in recognition of his contributions to the naval electronics program during World War II. He was cited for "outstanding work" as associate director of the research laboratories of the R.C.A. Laboratory Division at Princeton, N. J., and for contributions to the development of a new technique for frequency modulated magnetrons "which were of vital importance to the naval electronics program."

Sales Engineering Course

The 1948 summer session will offer a course in sales engineering, covering the selection of equipment to meet various situations in the machine tool industry and the accepted methods of selling this equipment to the customer. This course, scheduled for the period from July 12 through July 23 and limited to an enrollment of 50, will be taught by Professor Harry J. Loberg of the Department of Industrial Engineering and a staff of 24 men, selected from both the university faculty and private industry. Applications for the course should be sent to the National Machine Tool Builder's Association or the American Machine Tool Distributor's Association.

Crandall Heads C.E. School

The new director of the School of Civil Engineering is Associate Professor Carl Crandall, C.E. '12, by appointment of President Edmund E. Day. Professor Crandall succeeds Director William Lindsay Malcolm who died on January 18. Associate Professor Howard M. Gifft will act as assistant to Professor Crandall. Crandall has been a member of the civil engineering faculty since 1914 and has held such positions as secretary of the faculty of the College of Engineering and member of the Cornell University Plantations Committee.

Prof. Carl Crandall

Control Engineering

The School of Mechanical Engineering has set up a course on control engineering which is designed to familiarize the student with the problems involved in using automatic controls, the equipment that is available for the solution of these problems, and the operation and behavior of automatic controls in typical industrial situations. The course, numbered 3670 and under the direction of Assistant Professor C. R. Otto, will consist of two lectures and a lab each week in which the following topics will be discussed: measurement systems, controlling processes, the operating characteristics of various control elements, and the control set-ups for actual installations. In order to carry out the last idea, lab equipment is now being erected in the West Mech Lab which will, by means of hydraulic analogs, simulate as closely as possible the procesess of industry.

E.P.'s Induct New Members

Twenty-nine new members were inducted into the Cornell Society of Engineering Physics at a meeting on March 3 in the Memorial Room of Willard Straight when, in accordance with the constitution, all those who had been enrolled in the department were considered eligible for membership. Professor Richard P. Feynman of the Physics Department spoke on the topic of relativity, attempting to give a qualitative picture of Einstein's deductions, following which refreshments were served.

Du Pont Fellowships Given

Fellowships in chemistry, mechanical and chemical engineering, and post-doctorate fellowships in chemistry were recently awarded to Cornell University by the Du Pont Company. Each post-graduate fellowship provides $1200 for a single person, together with an award of $1000 to the University. A post-doctorate fellowship gives $3000 to the recipient, with a grant of $1500 to the University. The grants to the University are intended to finance tuition and fees, and whatever funds remain are to be used by the administering department as it sees fit.

(*Concluded on page* 32)

The Editor's COLUMN

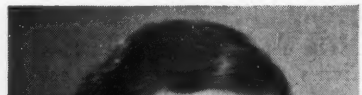
Exemptions

As the middle of the term draws near, the old question of exemptions from final examinations again raises its head to plague not only the students, but the faculty. The arguments for and against exemptions have been aired again and again, but in the long run it is the individual instructor who decides whether a student shall take the final or not. This is as it should be, for the instructor has had a chance to observe the student throughout the term, and should have a fairly good idea of how well he has mastered the subject matter of the course.

The main argument against exemptions seems to be that no matter how well a student had done during the term he cannot help but learn something by reviewing for finals. Those who favor no exemptions further point out that such a review furnishes a comprehensive view of the course that is unobtainable from doing day-to-day assignments. On the other hand, the proponents of exemptions feel that most studying for finals is nothing but cramming, and that the student is placed at a definite disadvantage in having to study both his strong and his weak courses at the end of the term. They argue that hard studying is necessary to do well on any final, and that the student would be better off in being allowed to concentrate on his weak subjects and be excused from the final in those in which he has already demonstrated a proficiency.

Both sides have valid arguments, and although there has been much faculty discussion on the matter, it is not likely that the various schools will set a definite exemption policy. As has been mentioned, the final decision rests upon the individual instructor. If he feels that a student has mastered the course, it would seem only fair to excuse him from the final, and allow him to spend his review time on those subjects in which he has not done well.

PROMINENT



Bill

William L. Hewitt, CE

Education never seems to end for Bill Hewitt, who first started college 13 years ago, is still at it, and plans to make a career of it. It all started when Bill, a native of Elizabeth City, North Carolina, entered the University of North Carolina to take mathematics, science, and education. He had time to earn his A.B. degree and do some teaching before he joined the Navy in 1940. He went through the first naval reserve midshipmen's course at Annapolis, was commissioned in May 1941, and spent some time in the Navy Diesel School at North Carolina State College. After thus preparing him, the Navy sent him on several assignments, such as engineer officer on a minesweeper and repair officer.

Bill was discharged from the Navy with the rank of Lieutenant Commander, and entered Cornell's Civil Engineering School in the spring term of 1946 with three terms' worth of credit from his work at the University of North Carolina and in the Navy. He is a member of the Cornell chapter of A.S.C.E., and has been elected to membership in Tau Beta Pi, national engineering honorary society and Chi Epsilon, Civil Engineering national honor society. Part of Bill's time is already spent teaching drawing in Lincoln, and he plans to continue this work after he has received his B.C.E. He expects to spend some time in industry, but thinks that teaching will be his career.

Norman E. Woonton, ChemE

Back in February, a unique experiment was carried out in Room 354, Olin Hall. It all started when a flask, part of a senior research apparatus devised by Norm Woonton and his lab partners, collapsed allowing three liters of 70% sulfuric acid to seep through the floor to the second floor, then to the first floor, etc. Though presumably not part of the original experimental procedure, we think the experiment very aptly demonstrates the porosity of the floors in Olin Hall, and must credit it as another step in the chemical engineering career of Norman E. Woonton.

This career started 24 years ago in Detroit, but, when he was 12, Norm moved to Syracuse and attended Central High there. Here his interest in sports became apparent, and he played on the tennis team.

Norm

ENGINEERS

Also during his spare time in 1940, he worked as a guide at the New York World's Fair. In the Fall of 1941, Norm entered Cornell and with New York State-Cornell Tuition and New York State Cash scholarships, he chose Chemical Engineering. His freshman year was not so crowded with work so that he couldn't find time to work on the Willard Straight Freshman Advisory and Social Committees.

But along in '43, the Army beckoned and Norm spent his next few years seeing most of Europe in the Artillery Ordnance. In the Spring term of 1946, he came back to the esteemed halls of Olin and counts on graduating this June with a B.Chem.E. degree.

This year Norm's most prominent

(*Concluded on page* 30)

Wm. F. Santelmann, Jr., EE

Attracted by Cornell's reputation and a John McMullen Scholarship, and urged on by a loyal alumnus of the class of 1906, Bill Santelmann entered Cornell from McKinley Technical High School in Washington, D.C.

He had time for four terms before the marines took him in 1945, and fortunately was discharged after only a year of service, after which he returned to Cornell.

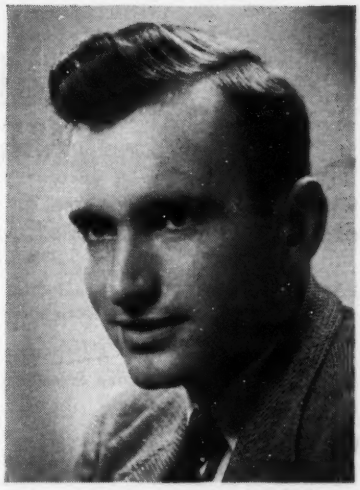
Bill

Electrical engineering seems to agree with Bill, as evidenced by his membership in Eta Kappa Nu, Tau Beta Pi, and Phi Kappa Phi, engineering honorary societies. In addition he is a member of the Cornell chapter of A.I.E.E., and during his second year was captain of the unit of the Pershing Riffles. Bill is now at work in an interesting activity—chief projectionist of the Willard Straight Theater. He is one of a staff of four projectionists who show the motion pictures presented often in the theater, and instruct two new trainees every year.

When asked where he intends to go after he receives his B.E.E. degree, Bill says he hopes to take a two-year course at the M.I.T. electronics laboratory, leading to a Master's degree.

Donald E. Sweetland, EE

Originally from Rochester, a suburb(?) of Irondequoit, N.Y., Don Sweetland now hails from the "biggest town in New York State." Such is the regard which Don holds for his present hometown—Irondequoit. Don was quite active at Irondequoit High School, serving as the assistant editor of the school paper, and advertising manager of the annual. It took just a few days after graduation for a rapid transformation to the V-12 unit of the Navy to take place, and in July, 1944, Don found himself at Cornell. Strangely enough, he had actually wanted to come to Cornell and the Navy had fulfilled his wishes, with the usual reservations of course. And as far as his choice of electrical engineering was concerned, it was just another application of the process of elimination. Don was offered Arts by the Navy (but that only took four terms), and M.E. and C.E. didn't quite appeal to him. What was left?—E.E.



Don

Nevertheless, Don has done quite well in his role since returning to school in the Fall of 1946 after a "stretch" in bootcamp. A member of A.I.E.E. and the Institute of Radio Engineer. Don is president of Eta Kappa Nu, national honorary electrical engineering society. The Delta Club has also enlisted his help for their parties.

However, don't let Don's winning smile fool you, for he has to admit that magic is his hobby! Dabbing in the mystic art of parlor tricks, Don has put on a few shows at home and only wishes he had all the money back he has spent on tricks. As added diversions, photography and astronomy interest him, and he is never so burdened that he can't cheer for Acacia in the basketball intramurals.

Announcing that he's "on the level now" by living on Highland Road, after two years of fighting Cornell hills when he was in the dorms, Don plans to graduate in June with a B.S. in E.E. Hoping for a job further west and looking forward to some better weather (Rochester weather is almost as bad as Ithaca weather), Don has no definite plans as yet. Working last summer with his roommate for Rochester Gas and Electric, Don got a taste of electrical engineering work, and recalls with a smile of those days spent with a bolo-knife in the "jungle" country surrounding Rochester in order to survey a high voltage line.

Cornell Society of Engineers

107 EAST 48TH STREET 1947-1948 NEW YORK 17, N. Y.

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"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

Carl F. Ostergren

President's Message

I was all set to write some paragraphs about Theodore Wright, not because I know him, but because several Cornell engineering friends of mine had told me what a great fellow he is, and what an asset he will be to Cornell—but just then the Alumni News came out with a good story about him and I tore up my notes. Anyway, welcome, Mr. Wright, or Doctor Wright as it may be. We are all much interested in the Buffalo areonautical laboratory, how it can be tied in with the Cornell engineering schools, and also in your more general assignments.

One of the greatest questions confronting University administrations, and in which the alumni are concerned, is the measure of expansion of our American college system. There are clearly two approaches. One is that the considerable expense of four- or five-year college training should be spent on those qualified to benefit from it, and in turn make their contribution to the progress of arts, science, government, and business.

The other school advocates the enrichment of the personal life which is derived from application to learning and the life in a college atmosphere, during the last of the formative years. When I was in Stockholm some years ago, I was told that street sweepers were college graduates, but I could not find any agreement as to whether that was a desirable condition. More recently, friends from Holland have told me about the high level of formal education among the men and women who occupy ordinary and even menial ranks.

The recent report of the Young Committee in New York State leans toward the second school, but advocates two-year colleges in or near the communities where the students' homes are. This seems to me a constructive proposal. Many of the families I know would feel unsatisfied if John or Jane stopped schooling at graduation from high school. Yet if there were no great scholastic promise and no great incentive to incur the cost of a full college course away from home, an attractive nearby junior college with a choice of either liberal or practical major courses would offer a satisfactory solution.

Such a program would also satisfy those who are keenly concerned to see the highest standards of scholarship maintained in the colleges to which they owe their allegiance. My guess is that graduates of the Cornell engineering schools, along with those of such schools at M.I.T., Michigan, California, Purdue, Lehigh (it gets embarrassing when you start to name names) will vote for highest teaching standards, carefully selected and qualified entrants, the good old system of busting out those who can't or won't keep up their grades, and at the end a degree which will command respect. Meanwhile the opportunity should be kept open for other high school graduates to go ahead with their studies.

Every college can't have 15,000 or more students, and the national government can't support every young man and young woman who wants to go to college, even though candidates for public office say so. At the same time the clearly demonstrated will of the people for greater educational opportunities for their children is a great sign.

CARL F. OSTERGREN

Out of Phase

By HERBERT F. SPIRER, EP '51

The Other Animals

Been spending a lot of time around the Art School lately, and I am not sure that it is the best way to spend time. Not that the atmosphere around G.S. is so bad. After all, it was there that I first discovered a coed who *didn't* wear slacks.

It's really the high handed approach to the courses that rubs my fur the wrong way. I tried out a homely little Philo. course taught by a certain professor whose name I won't mention, since mentioning it brings to mind the colour of mourning clothes. The second week of the term he very pleasantly suggested that at the next meeting (that's what they call a lecture over there) we should turn in a discussion of a two sentence quotation he selected.

Well I took those two sentences home, worried them a bit, did a small mental titration, and discussed them. My discussion consisted of listing what I thought was wrong with the argument. The complete discussion, written in large, sprawling longhand plus one footnote covered one side of a sheet of typewriter paper, which seemed to me quite adequate.

Merrily I bounced into class bearing my single sheet of foolscap on silver platter, only to discover that some of my classmates were handing in bound volumes, thick folders, and suitcases crammed with manuscripts, several of which were profusely illustrated with cartoons, portraits and assorted graphs. But I wasn't discouraged, "Ha," I thought, "Ha! At least you have everything down, even if it isn't too flowery, good for a seventy-five in any man's language."

The Great Fault

Came the dawn, and the papers were returned. Several Arts Students uttered little squeals of joy and rushed out to their publishers. Trembling with fear, I peered at my little, but potent, masterpiece. There written across my delicate script in red ink was, "Unsatisfactory." Which ain't good. And what was wrong? Had I missed the point? Was there a logical fallacy that had somehow slipped by? Was the argument ridiculous? Had I integrated between the wrong limits? Was a complete lack of understanding in evidence? No! The great fault was given in red ink at the bottom of the page . . . "Too Short." Hmph!

Of course, I am willing to present the other side of the story, an act of kindness unknown to the Widow. Met a Freshman English teacher named Stumpf who claimed that Sibley was out of step, not G.S. It seems that he had an engineer in his English class. A nice quiet fellow who would do calculus problems during class and thus allow the class to procede without discord. The English final that term came on a Wednesday. It went off without a hitch at 8 AM the scheduled Wednesday. The following Saturday, however, Mr. Stumpf was roused from his slumbers at 8:30 AM by a telephone call. It was our frosh engineer. "Hey!", he shouts, "What's going on here? I'm up here all alone. Where is everybody?"

Help At Last

I have been watching with considerable interest the various right- and left-hand rules springing up on every side. Every Professor and instructor seems to have his own pet version, and Sears has twenty or thirty favorite variations. Fortunately, Out of Phase will not let you down. We have evolved a simplified, error-proof, right-hand rule than any two-year old child or EE senior can use without fear of error.

Follow this rule, step by step, and you can't go wrong:

THE SITZFLIESCH RIGHT-HAND RULE

1. Raise your right hand.

If you are right-handed, it is the one you write with. If you are left-handed, it is the other one. If still in doubt, practise rightfacing, having your roommate call out the commands. The direction in which the greatest number of turns are made will be right. Turn your head in this direction, then lower your eyes. You should now be looking at your right hand. We realize that there may be veterans who have mastered neither writing nor ROTC. In this case it is recommended that you go to the center of State Street at Aurora. Stand in the center of State Street facing up the hill. Take the first bus that comes along. If it takes half an hour to get to the Lehigh Station, the bus was on your right side. If it takes ten minutes to get to the Station, the bus was on your left side, in which case the right hand was the other one. If this doesn't cure your dandruff send the unused twenty-five gallons of Vitalis to the Bald Men's Temperance League of Peoria, Ill., and you will receive your hair back by return mail.

(Concluded on page 26)

ALUMNI AND

Richard R. Lyman, M.C.E. '03, Ph.D. '05, as a consulting engineer in Salt Lake City, Utah, has devised a new system of street numbering that has been put into use in that and other Utah cities.

Walter S. Carpenter, Jr., M.E. '10, president of Du Pont since 1940 has resigned that position to become chairman of the Board, following the retirement of Lammont du Pont from the latter post. Mr. Carpenter left Cornell in his senior year to work for Du Pont in Chile. In 1911 he came to Wilmington as a member of the staff of the Development Department. Six years later he became director of that department, and in 1919 was made director and member of the Executive Committee, and vice-president in charge of the Development department. Three years later he was made treasurer of the company and a member of the finance committee, and in 1926 was made vice chairman of the finance committee. In 1930 he became chairman of the finance committee, and attained the presidency in 1940. Mr. Carpenter's election as

Walter S. Carpenter, Jr.

Board Chairman brings to the highest level his career with Du Pont that began in 1907.

Thomas R. Rollo, '10, is a consulting engineer in private practice in Wyocena, Wisc.

Edgar F. Wendt, M.E. '10, president of Buffalo Forge Company, has been named a regional vice-president of the National Association of Manufacturers.

Clayton S. Coggeshall, M.E. '11, has been appointed manager of sales of the turbine and gear division of the apparatus department of General Electric Company in Schenectady, N. Y. He became associated with General Electric in 1911 and since 1938 has been manager of the former turbine sales division.

Felix S. Hales, C.E. '16, has been made vice-president in charge of operation of the Nickel Plate Road, the New York, Chicago & St. Louis Railroad Company, with headquarters in the Terminal Tower Building, Cleveland, Ohio.

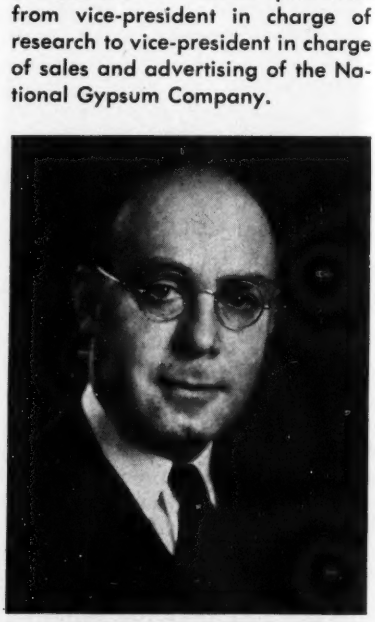
Herman Halperin, M.E. '20, is staff engineer of the Commonwealth Edison Company, Chicago. He was elected to the Society of Sigma Xi last spring after investigations on various types of underground power cables and lightning protection.

Henry M. Beatty, E.E. '22, is vice-president in charge of operations for Kelley Island Lime & Transport Company. He is also president of the US Figure Skating Association and chairman of the Olympic Committee for Figure Skating this year.

Walker L. Cisler, M.E. '22, has been named executive vice-president of the Detroit Edison Company, Detroit, Mich., with responsibility for employment, personnel, and medical and safety departments. He has been chief engineer of Edison's power plants. Formerly a member of General Eisenhower's staff in Europe, where he directed the re-establishment of utility services, Cisler is a consultant for the US Atomic Energy Commission.

Edwin H. Krieg, M.E. '22, presented a paper at the annual meeting of the American Society of Civil Engineers on "The Cost Trends in Steam-Electric Power Generation." Mr. Krieg is chief design engineer for American Gas and Electric Service Corporation.

Dean D. Crandell, B.Chem.E. '22, of Buffalo, has been promoted from vice-president in charge of research to vice-president in charge of sales and advertising of the National Gypsum Company.



Clayton S. Coggeshall

Edwin L. Harder, E.E. '26, is a consulting transmission engineer for the Westinghouse Electric Corporation.

W. L. Cressman, C.E. '27, formerly district manager for the American Rolling Mill Company in Pennsylvania, has moved to Middletown, Ohio, to become manager of Eastern sales. **Joseph S. Thomas, M.E. '27,** is assistant director of purchases of the same company; and **W. B. Quail M.E. '19** is manager of central sales. With Armco International Corporation, subsidiary of the American Rolling Mill Company, are **Fred Dorner, M.E. '27,** as sales engineer, and **H. A. Benedict, M.E. '27,** manager of sales.

WHAT THEY ARE DOING

Robert W. Waring, M.E. '30, resigning from the Bridgeport Brass Company, became assistant chief engineer of the Bullard Company of Bridgeport, Conn.

William M. Anderson, Jr., CE. '32, is director of purchases in the home radio division of the Westinghouse Electric Corporation in Sunbury, Pa.

Norman E. Wilson, B.S. in E.E. '37, formerly associated with the Commonwealth and Southern Corp., Jackson, Mich., has joined the staff of the electrical engineering department of the University of Massachusetts, Amherst, as an associate professor. Mr. Wilson received his master's degree in electrical engineering from the Illinois Institute of Technology in 1947.

Wallace R. Seeley, M.E. '43, is working for a Master of Business Administration degree at Harvard Business School.

F. Weston Whittier, M.E. '44, became assistant product engineer for the Western Electric Company in Allentown, Pa., after being sales engineer for a boiler manufacturing company.

Robert J. Addicks, M.E. '45, is a plant layout draftsman for the Stanley Works, hardware manufacturers, New Britain, Conn.

Laurence Aquadro, M.E. '46, is an engineer of the Dupont Nylon plant in Martinsville, Va.

Robert L. McMurtrie, B.C.E. '46, has become assistant supervisor of track for the Pennsylvania Railroad in Trenton, N. J.

Max R. Bluntschli, M.E. '47, has an engineering position in the mechanical development section of the Container Corporation of America. He is working under Leonard J. Lewis, '29. Other Cornellians with the firm are **Johnson N. Hunsberger III, '45; Richard F. Ennis, Jr., '45;** and **James S. Bradshaw, '46.**

Gordon K. Dingle, B.M.E. '47, is a mill engineer with the US Gypsum Company in Sweetwater, Tex.

Deceased

Col. William G. Atwood, C.E. '92, consulting engineer executive. After the first World War, Colonel Atwood served as director of the Division of Communications in Central Europe of the American Relief Administration, having charge of the re-establishment of railroads. He also headed the American Railway commission to supervise the reconstruction of Serbian railways. Colonel Atwood was a former president of the American Relief Administration Association and the Society of Military Engineers, and was assistant engineer of the Southern District, Division of Valuation, Interstate Commerce Commission. In 1919 Colonel Atwood served as United States Transportation representative on the Supreme Economic Council in Paris. He was the technical adviser to Yugoslavia in 1920 and a consulting engineer from 1924. He directed the Marine Piling Investigation for the National Research Council and was author of "Marine Structures, Their Deterioration and Preservation."

Ezra Frederick Scattergood, M.M.E. '99, advisory engineer, Department of Water and Power, for Los Angeles, Calif. He instructed at Rutgers, where he had received B.S. and M.S. degrees, and at the Georgia School of Technology as a professor of physics and electrical engineering. He was made electrical engineer of the City of Los Angeles in 1911 and retained that appointment until 1940, when he retired and was named a consultant to the city's power division. Mr. Scattergood was an authority in the fields of hydraulic and electrical engineering. His activities included membership on the advisory committee for California in 1933; advisory engineer to the President's National Power Policy Committee on Preparedness, 1939-40; president of the American Public Power Association, 1947.

Richard H. Depew, M.E. '11, pioneer American aviator, who

Richard H. Depew

held many important positions in the aviation industry. At his death he was director of sales for the Frank Ambrose Aviation Corporation of Flushing, L. I. He was chief of the aircraft disposal section of the War Assets Administration.

Mr. Depew was at the controls of the first government mail plane on its initial flight in 1918. As a charter member of the Cornell Aero Club, he built and flew gliders in Ithaca in 1910. He was an Army test pilot during the first World War, and was associated with Curtiss Aeroplane and Motor Corporation and later, with Fairchild Aviation Corporation. From 1938 to 1943 he was executive vice president of the Taylorcraft Aviation Corporation at Alliance, Ohio. He was a member of the Society of Automotive Engineers, the Institute of the Aeronautical Sciences, and the Aeronautical Chamber of Commerce of the United States. He had been a governor of the National Aeronautic Association, regional director of the New York State Aviation associations, and a member of the Aeronautical Education Commission.

Charles F. Lovan, C.E. '24, partner of Hillyer and Lovan, Jacksonville, Fla., was killed in an airplane accident.

Recent Developments In Engineering

Techni-Briefs

"Night Vision" Tester

Details of a "night vision" tester used to classify Army fliers according to their ability to see at night have recently been disclosed. Known as the AAF-Eastman Night Vision Tester, the instrument works through matching of test objects in a darkroom on the ground. It was developed under security regulations and was used by the AAF during the war.

The device consists of an enclosed projector and screen, six individual recorders, and connecting equipment. In the tests aviation cadets look at a black object, known as a Landolt ring, which resembles an enlarged letter C. This is viewed against a faintly illuminated background screen. The examinees, seated at individual recorders, match similar C-shaped rings against the position of the master ring during the seven seconds before it changes automatically to a new position. The screen is darkened progressively by means of a filter arrangement after every five presentations. During a standard test series of 40 presentations brightness is reduced eight times.

Medical officers have stated that during night vision studies it was found that men tested on the instrument showed considerable improvement in performance on retests. Considerable ability in learning an "off-center" principle of seeing at night was also noticed among those using the device.

"Packaged" Generator

The new Regulectric Generator announced by the Electric Machinery Mfg. Company for use in engine-generator sets is a compact, factory-assembled unit including revolving-field generator, direct-connected exciter, automatic voltage regulating circuit, meters, and selector switch for pre-setting voltage. The only external connections needed are leads to a generator switch.

The built-in automatic voltage regulating circuit has no moving parts and requires no maintenance; it is permanently connected and factory adjusted to hold terminal voltage within 2% of the voltage selected, at any load or power factor within the generator rating. The principle of electric resonance, long used for needle-sharp tuning of radios, is used to hold constant voltage.

Improved Exposure Meter

One of the features of a new photographic exposure meter made by General Electric is a polystyrene plastic lens, which is said to increase substantially the photometric efficiency of the meter. Designed in cylindrical form with only a slight curvature of the axis, the lens, molded by the G-E Plastics Division, improves distribution of light on the surface of the photocell and thereby increases its response to the light flux from a given solid angle.

G.E.'s new exposure meter incorporates a plastic lens and a "memory" mechanism. *—Courtesy General Electric Co.*

In addition to the new lens, the new meter is provided with other features which make it more convenient to use; in fact, it has been described as having a "memory." It has a pointer-locking mechanism which records the light measured by the photocell; a louver-coupled dial which "remembers" to shift the meter automatically from high light to low and back again as the scene requires, and the trident analyzer which "reminds" the photographer to check the range of light on the subject.

Banishes Tattle-tale Gray

A chemical compound, relatively new commercially, can play an increasingly important role in the housewives' never-ending fight to make white clothes stay white longer, and banish "tattle-tale gray." The compound, developed by DuPont, has a long, involved name—sodium carboxymethyl cellulose—but its action, building up the cleansing ability of soaps and synthetic detergents, is straight-forward and to the point. Sodium CBS, as the compound is called, when added to synthetic detergents and soaps, aids in preventing the redeposition of dirt on the fabric. Thus, it makes possible almost complete cleansing, resulting in brighter clothes and white cottons that stay white after successive washings. In addition, tests reveal that with the addition of this new chemical, detergents and soaps do their jobs more effectively in less time.

Is that "HER" voice?

Yes, indeed. That figure 1 up there, with hundreds of zeros trailing after it, represents the number of times "her" voice is amplified when she telephones you from across the country. Even on shorter calls, the total is tremendous.

The reason is that circuit resistance reduces the current which carries the voice. So every few miles vacuum tube repeaters refresh it by boosting its power as much as a million times.

The task of preparing new pathways for the voice occupies many qualified engineers. Tubes and amplifiers must be designed. Cable and intricate mechanisms must be produced. The lines themselves must be extended—over mountains and prairies, under rivers and through city streets—wherever the voice must travel.

Engineers who have a part in this job know there's a future in telephony.

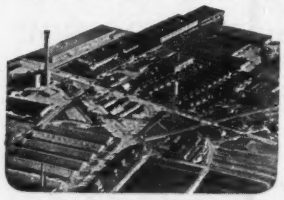
BELL TELEPHONE SYSTEM

Refrigerated Trucks Loading Frozen Foods.

World's Largest Quick-freezer Uses

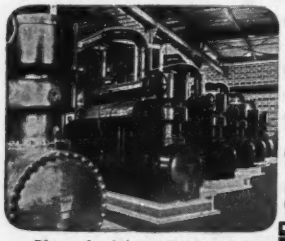
FRICK Refrigeration

Seabrook Farms—Deerfield Packing Corp. are breaking all records for quick-freezing foods at their gigantic plant near Bridgeton, N. J. They are processing as much as a million pounds of vegetables and fruits a day, 85% of which are promptly frozen.



Air View of the Great Plant near Bridgeton, N. J.

Their precooling, quick-freezing and cold storage operations are all handled with Frick Refrigeration. Storage capacity is over 50 million pounds. Twelve big Frick ammonia compressors, driven by motors totaling 3825 horsepower, carry the cooling load with dependability.



Six of Nine Frick 4-Cyl. Amm. Compressors.

● The Frick Graduate Training Course in Refrigeration and Air Conditioning now in its 31st year is approved under the G.I. Bill of Rights.

FRICK CO. WAYNESBORO, PENNA. U.S.A.

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Tutoring in university courses that is effective because directed to individual needs.

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MAXWELL T. KENDALL '36, *Headmaster*

***Use the* CORNELL UNIVERSITY PLACEMENT SERVICE**

Administration Building, Ithaca
John L. Munschauer '40, Director

New York Office, 107 E. 48th St.
Paul O. Reyneau '13, Manager

Out of Phase

(*Continued from page* 21)

2. Point your index finger in the direction of the electrostatic induction field.

Just remember, electrostatIc iNduction fielD. (INDex—get it?) The index finger should be found next to the thumb. If it is not, then you must have your left hand or either foot. Go back to step one, wait two turns, and start over.

3. Extend the little finger in the direction of the winding.

According to Schultz[1] the winding may be found somewhere on the frame on which it is wound. This should present no problem to the inexperienced student, and the proof of this theorem is left as an exercise for the more eager students. All the others will be busted.

4. Should the hand now begin to tremble so badly that the directions of the fingers are unsure, secure the hand by firmly grasping the wrist between the teeth.

Be sure not to allow blood to drip on the machinery. This is, we caution, not the only approach to this problem.[2]

5. Rotate the middle finger so that its angle of rotation is proportional to the ring integral of the magnetic inference over a closed beer bottle.

---

1. Schultz, Theo.: *How to Locate the Winding on a Coil,* Ithaca, 1948. Out of print.
2. A full discussion may be found in; Branch: *A Dynamic Investigation of the Theory of Nervous Tremors in Engineering Students taking Elementary Physics Courses,* Ithaca, 1947. Vol. 75, pp. 18956 to 18958.

This one step has in it the essence of a five year engineering education. It also shows the great advantage of this simplified method of a right-hand rule over the old vector product method, which required a six-year course in vector analysis.

6. Write down the correct answer.

This will probably be found in the back of the book.

This method has worked for us for years and is undoubtedly the most straight forward method on the market today. Any questions that may arise from unforeseen complications will be answered by this column on the receipt of a penny postcard to which is attached an old prelim book to cover the cost of mailing.

The Piano Business Gets a LIFT... when Alcoa Aluminum Castings Replace Heavy Metal

Even a well-trained husband who'll rearrange the living room every Spring balks at piano-moving. You can see the main reason above. It's the big metal plate that holds the strings—and it has always tipped the scales at around 125 pounds.

No wonder it gave the piano business a *lift* when a progressive piano builder replaced the heavy iron plate with one weighing 45 pounds—made of Alcoa Aluminum. As perfected, this big casting from our foundries is strong to resist the 18-ton pull of the taut strings. It is stabilized to provide tonal quality and stay in tune. And its cost today is competitive with the old-fashioned cast-iron plate.

With other advantages, in other industries Alcoa Castings are effecting similar changes. In one plant, their corrosion resistance means no painting, simple finishing. In another, they are liked for their superior machinability. In still another, they are preferred for the ease with which they swing through production, where iron castings had to be hauled by truck or hoisted on heavy cranes.

The change from heavy metal castings to Alcoa Aluminum Castings is a revolutionary switch in product engineering. Old, old habits are being questioned as engineers re-evaluate metals—with a sharper eye than ever before focused on Alcoa Aluminum. ALUMINUM COMPANY OF AMERICA, Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN **ALUMINUM**

ALCOA 1888 1948 60 YEARS OF SERVICE

Just 60 years ago six young men started a tiny business in a little shed in Pittsburgh. They began to make aluminum by a new process. That was the beginning of what is now Alcoa. Alcoa's aim, then and now, was to make aluminum cheaper and more useful. How successfully that has been done is shown by the fact that America today has the greatest aluminum industry in the world, employing around 1,000,000 people in the manufacture of aluminum in its many shapes and forms or in making many useful products in which aluminum plays an essential part.

Cable Sheathing

(*Continued from page* 8)

polyethylene ranks high in resistance to water penetration. Also, it is tough and flexible, with great fatigue endurance, and is readily extrudable.

It was therefore determined that the filler in the sheath sandwich should be extruded polyethylene. The outer sheath should be corrugated brass with soldered seam, as in the experimental cable, but protected against corrosion by the lead coating referred to above. The inner sheath should be of corrugated aluminum with the overlap sealed with an organic compound. Aluminum was chosen for its availability and good conductivity, the latter being of importance since, among its other functions, the sheath must serve as a shield against external electrical disturbances. Sheath of this type will shortly be in experimental production, and will be primarily for aerial installation.

This design with a triple barrier against the entrance of moisture will, it is believed, be more reliable than a lead sheath. In fact, the excellent properties of polyethylene naturally raise a question as to whether a triple-barrier design is necessary. And as the lead shortage which arose in 1946 made it urgent to get into production with some type of non-lead sheath as quickly as possible, it was decided to develop a two-element sheath using one layer of polyethylene and one layer of metal. In this connection, omission of the outer soldered brass sheath made it possible to advance the production date, since the soldering operation required manufacturing development and preparation time and effort.

A stub of Alpeth cable showing the construction of the two-layered sheath.

Evolve Double Barrier Design

The doube-barrier design thus evolved consists of an inner corrugated aluminum sheath, the overlap being sealed by an organic compound, covered with an extruded layer of polyethylene compounded with other materials to make it

(*Concluded on page* 30)

HIGGINS
AMERICAN WATERPROOF INDIA INK
Now available with
Cork and Curved Quill Stopper
OR
Perfected Rubber Dropper Stopper
Both type stoppers available on waterproof black.
When ordering from your dealer, specify the type stopper required.
HIGGINS
AMERICAN INDIA INK
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K & E Pocket Slide Rules
at $5.75 and $6.50

Past Pocket Slide Rules
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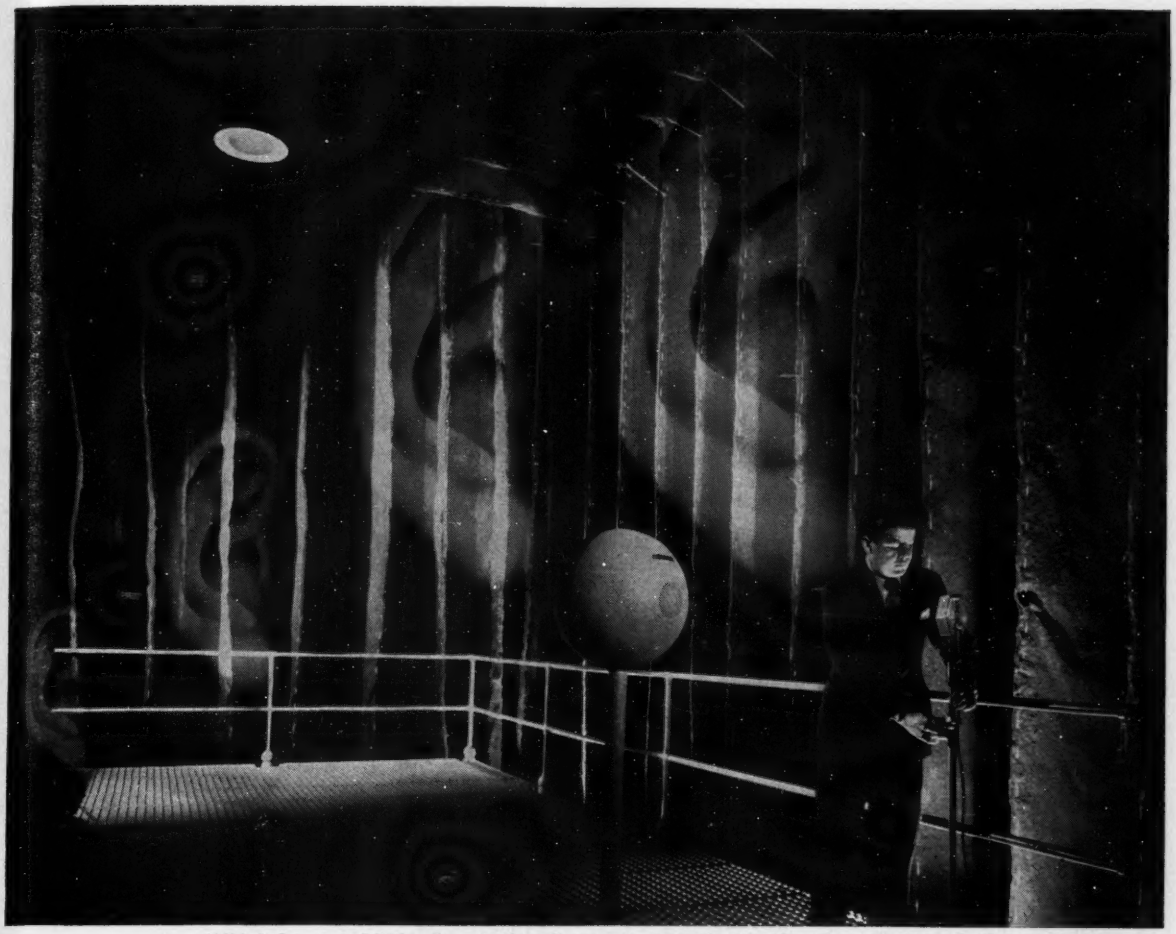
Your friend indeed when working in the field.

TRIANGLE BOOK CO-OP



RCA Laboratories' "Chamber of Silence"—proving ground of tonal quality in radio and television instruments.

Ever hear SILENCE?

You walk into an eerie room. The door swings shut and you're wrapped in a silence so complete that it's an effort to listen. Sound in this vault-like cavern is reduced to the minimum of hearing.

But even *silence* has a sound of its own. Faintly you hear a subdued hiss; sometimes a soft hum. Scientists have suggested this may be the "noise" of molecules hitting the eardrums. Others wonder if it is caused by the coursing of the body's blood stream.

When acoustic scientists at RCA Laboratories want to study the actual voice of an instrument, they take it to this room. What they hear then is the instrument itself—and only the instrument. They get a true measure of performance.

Information gained here is part of such advances as: The "Golden Throat" tone system found only in RCA Victor radios and Victrola radio-phonographs . . . superb sound systems for television . . . the true-to-life quality of RCA Victor records . . . high-fidelity microphones, clear voices for motion pictures, public address systems, and interoffice communications.

Research at RCA Laboratories moves along many paths. Advanced scientific thinking is part of any product bearing the names RCA, or RCA Victor.

When in Radio City, New York, be sure to see the radio, television and electronic wonders at RCA Exhibition Hall, 36 West 49th Street. Free admission. *Radio Corp. of America, RCA Building, Radio City, N. Y. 20.*

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

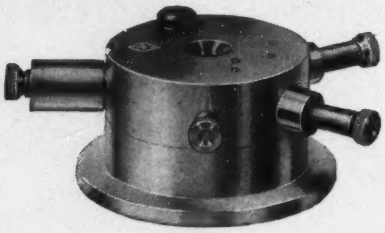
- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and reproducing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey.

Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RADIO CORPORATION of AMERICA

FOR RESEARCH IN
RADIOACTIVITY



3¼" x 2⅜" x 1⅜"; Weight 3½ oz.

Lindemann Electrometer

This instrument was originally designed for use in connection with photo-electric measurements of light in astronomical work. It is now used extensively for the determination of radioactive emission. Compact and stable, it has high sensitivity, stable zero, and does not require levelling. The capacitance of the instrument is less than 2 cm. For general use, the instrument is placed upon a microscope stand and the upper end of the needle observed, illumination being obtained in the usual way through a window in the electrometer case.

Write for descriptive literature

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Pioneer Manufacturers of Precision Instruments
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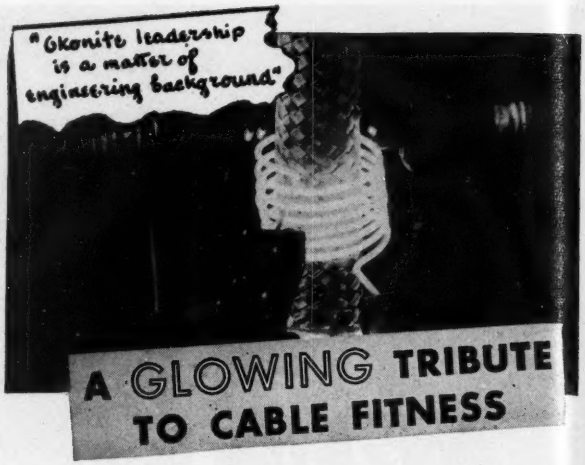
pH Meters and Recorders, Galvanometers, Gas Analyzers, Fluxmeters, Exhaust Gas Testers, Surface Pyrometers, and other Electrical and Mechanical Instruments for Use in Science, Industry and Medicine



Is a cable covering flameproof? Will it resist high temperatures when it comes to actual service?

Long before a cable is manufactured, questions like these are answered in the Okonite laboratories, proving ground and in various testing departments of the Okonite plants. The picture above shows a flame test. The measured current that makes the coils glow makes it possible to reproduce test after test without variation. The Okonite Company, Passaic, New Jersey.

OKONITE OKONITE SINCE 1878 5238
insulated wires and cables

Cable Sheathing

(*Continued from page* 28)

suitable for direct outdoor exposure. The inter-space between aluminum and polyethylene compound is sealed with a suitable flooding compound. Although in this design called "Alpeth" (Aluminum-polyethylene) the brass sheath is omitted, it is suitable for use either aerially or in ducts and thus has a wider field of application than brass sheath which was not intended for use in ducts. The Western Electric Company by intensive effort started production of Alpeth sheath at both their Kearny and Hawthorne plants in September of 1947.

It is certain that polyethylene when new is a satisfactory component of Alpeth sheath; hence, the only problem it presents is to insure that it will remain satisfactory over the period of years desired for the life of a telephone cable. To this end, our Chemical Laboratory has conducted an intensive investigation of various polyethylene compounds, based principally on accelerated life tests and supplemented in so far as possible by exposure tests under severe outdoor conditions. These accelerated tests indicate a satisfactory and economical life expectancy.

Cooperative Effort Essential

As in the case of lead substitutes for cable sheathing material, cooperative effort characterizes much that the engineer does today. Tasks that to the layman may seem inherently simple are likely to demand the united techniques of a variety of experts. Nor are the larger engineering projects especially outstanding in this respect. An innocent looking change at one point may reverberate through the whole of a complex mechanism or technical process. All up and down the line from the large to the small, the balance of functions and the harmonizing of materials can be insured only by the focusing of diverse fields of knowledge.

Prominent Engineers

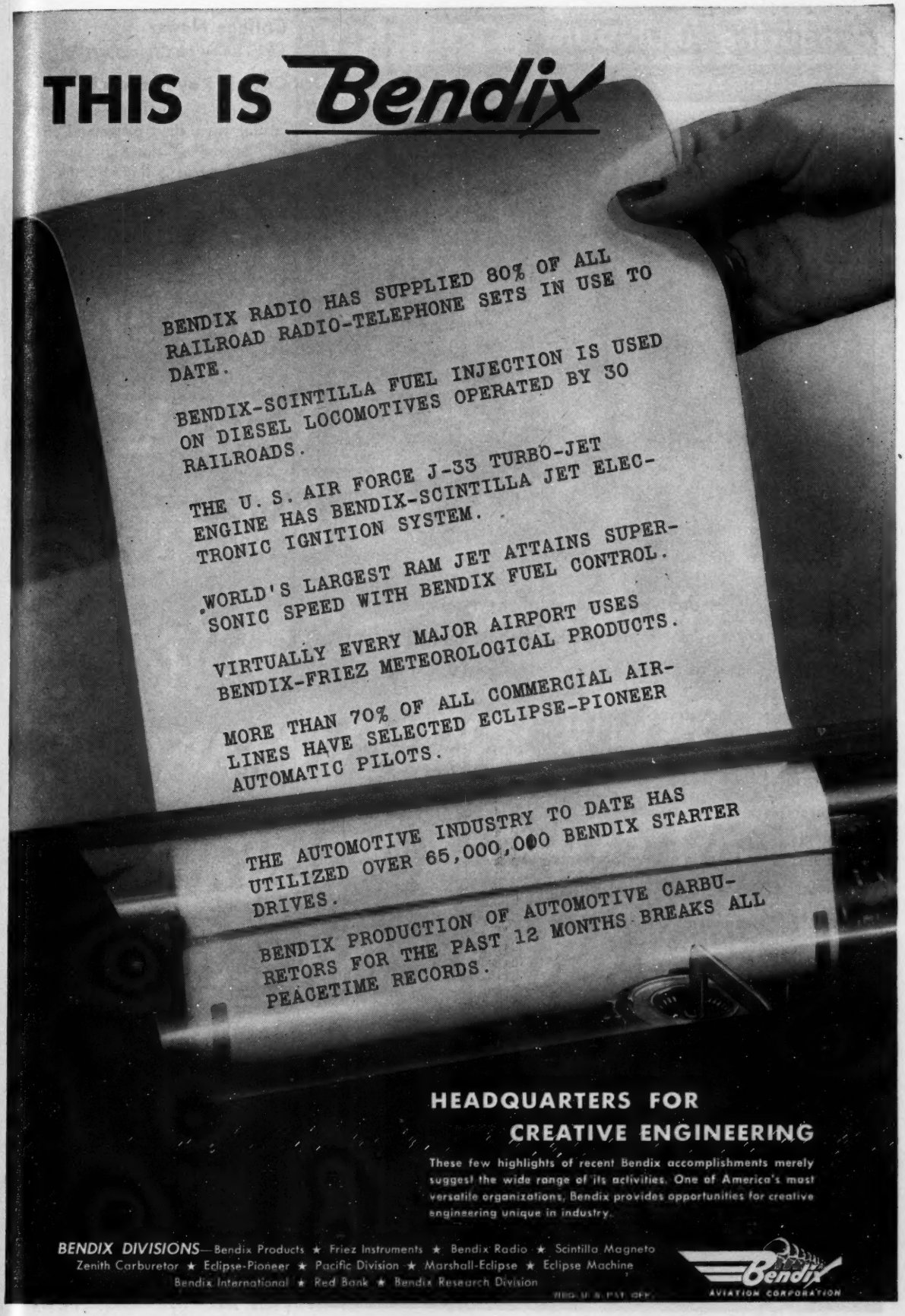
Norman E. Woonton

(*Continued from page* 19)

activity has been as president of the student chapter of A.I.Ch.E. Last year he was president of his fraternity, Sigma Chi, and a member of the Straight Social Committee. The Chem.E. Student Council takes part of his time, and Tau Beta Pi, the honorary engineering society, claims him as a member.

Norm's main concerns now that graduation is approaching are "getting married, finding a place to live, and getting a job." The first he seems to have pretty well taken care of for he plans to be married five days after graduation. But his future home and job are still questions to be answered. His summer work last year at a penicillin plant in Syracuse was interesting, but the administrative end of engineering seems to attract him more than the technical or research field. The big advantage of chemical engineering, Norm believes, are the many possibilities and branches of this new phase of engineering.

THIS IS *Bendix*


BENDIX RADIO HAS SUPPLIED 80% OF ALL RAILROAD RADIO-TELEPHONE SETS IN USE TO DATE.
BENDIX-SCINTILLA FUEL INJECTION IS USED ON DIESEL LOCOMOTIVES OPERATED BY 30 RAILROADS.
THE U. S. AIR FORCE J-33 TURBO-JET ENGINE HAS BENDIX-SCINTILLA JET ELEC-TRONIC IGNITION SYSTEM.
WORLD'S LARGEST RAM JET ATTAINS SUPER-SONIC SPEED WITH BENDIX FUEL CONTROL.
VIRTUALLY EVERY MAJOR AIRPORT USES BENDIX-FRIEZ METEOROLOGICAL PRODUCTS.
MORE THAN 70% OF ALL COMMERCIAL AIR-LINES HAVE SELECTED ECLIPSE-PIONEER AUTOMATIC PILOTS.
THE AUTOMOTIVE INDUSTRY TO DATE HAS UTILIZED OVER 65,000,000 BENDIX STARTER DRIVES.
BENDIX PRODUCTION OF AUTOMOTIVE CARBU-RETORS FOR THE PAST 12 MONTHS BREAKS ALL PEACETIME RECORDS.

HEADQUARTERS FOR CREATIVE ENGINEERING

These few highlights of recent Bendix accomplishments merely suggest the wide range of its activities. One of America's most versatile organizations, Bendix provides opportunities for creative engineering unique in industry.

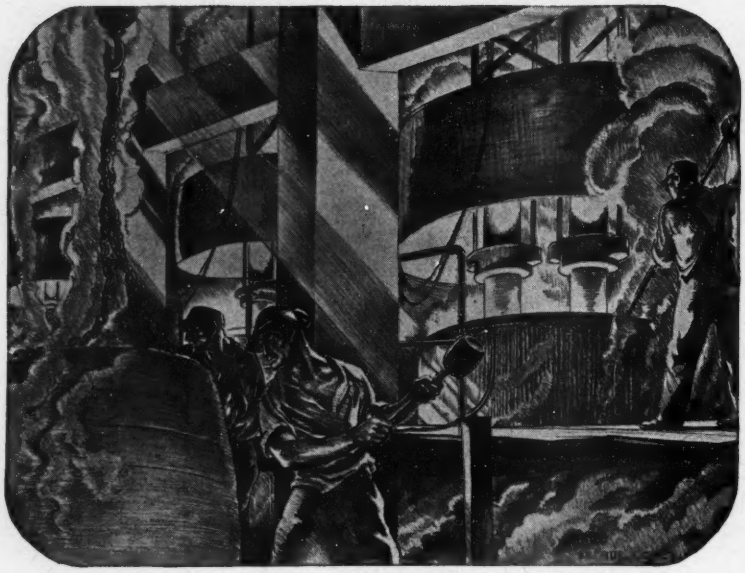
BENDIX DIVISIONS—Bendix Products ★ Friez Instruments ★ Bendix Radio ★ Scintilla Magneto
Zenith Carburetor ★ Eclipse-Pioneer ★ Pacific Division ★ Marshall-Eclipse ★ Eclipse Machine
Bendix International ★ Red Bank ★ Bendix Research Division

REG. U. S. PAT. OFF.

Bendix
AVIATION CORPORATION

Producing ALUNDUM

the world's most widely used abrasive



IN these unique, arc-type furnaces at the Norton electric furnace plant near Niagara Falls is produced ALUNDUM abrasive—fused at 3700° F. from the mineral, bauxite.

Introduced to industry by Norton in 1901 this first electric-furnace-made aluminum oxide abrasive revolutionized the grinding of steels because of its combination of hardness, sharpness and toughness.

Subsequent Norton developments were designated as 38 ALUNDUM and 57 ALUNDUM—and then in 1946 came the sensational 32 ALUNDUM abrasive.

Today ALUNDUM abrasive in its various forms is the world's most widely used abrasive.

NORTON COMPANY • WORCESTER 6, MASS.

(BEHR-MANNING, TROY, N. Y. IS A NORTON DIVISION)

NORTON

ABRASIVES — GRINDING WHEELS — GRINDING AND LAPPING MACHINES
REFRACTORIES — POROUS MEDIUMS — NON-SLIP FLOORS — NORBIDE PRODUCTS
LABELING MACHINES (BEHR-MANNING DIVISION) COATED ABRASIVES AND SHARPENING STONES

College News

(Continued from page 17)

Cosmic Ray Research

A more thorough investigation of cosmic rays, their cause and effect, will be one of the major projects undertaken at a high-altitude laboratory to be established under the joint supervision of five universities on the summit of 14,000-foot Mt. Evans in Colorado. This coordination of efforts, the first of its kind in the field, will put the combined talents of Cornell University, New York University, the University of Chicago, the University of Denver, and the Massachusetts Institute of Technology, to work on the problem. The factors involved in this complex question can better be solved in places of rather rarified atmosphere where the high energy radiations from outer space have not been weakened to an appreciable degree by extensive collisions with air molecules. This study has been carried on to a limited degree on Mt. Evans during the past fifteen years but the inadequate facilities existing throughout that period have obviated any large-scale efforts.

AIEE Competition

The Ithaca Section of the AIEE Student Branch is at present sponsoring a student paper competition open to undergraduate members of the society. The two top papers will merit their authors twenty-five dollars and fifteen dollars respectively and will give at least one of these men the opportunity to read his paper at the District I convention of the AIEE Student Branch. This convention, scheduled for April 30 at New Haven, Conn., will feature a competition on the same order as the local contests. The Ithaca section competition is under the direction of Associate Professor W. H. Erickson.

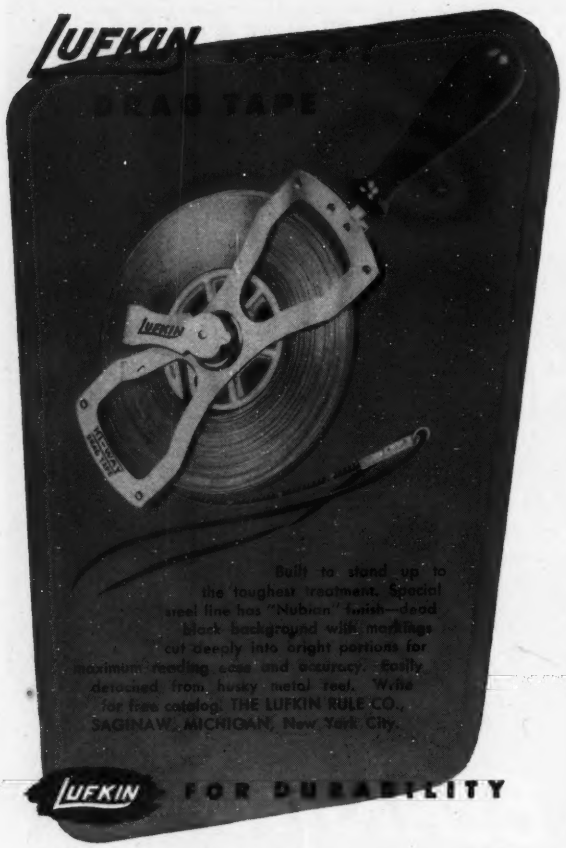
OMISSION:

"Engineering Drawing", reviewed by Professor H. T. Jenkins in the March, 1948, issue of the ENGINEER, is published by McGraw-Hill Book Co., Inc., New York, 1947.

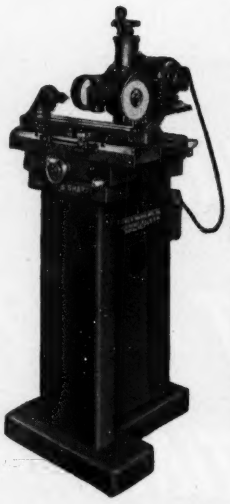
A page for **YOUR BEARING NOTEBOOK**

A FACT WORTH REMEMBERING! Yes, and we're saying it good and loud because it explains one of the basic reasons why 9 out of 10 bearing applications can be handled more efficiently with Timken tapered roller bearings.

As an engineer you'll run into many important problems involving bearing applications. If you'd like to learn more about this phase of engineering we'll be glad to help. Don't forget to clip this page for future reference—and, for additional information write today to The Timken Roller Bearing Company, Canton 6, Ohio.


LUFKIN
DRAG TAPE
LUFKIN
Built to stand up to the toughest treatment. Special steel line has "Nubian" finish—dead black background with markings cut deeply into bright portions for maximum reading ease and accuracy. Easily detached from husky metal reel. Write for free catalog. THE LUFKIN RULE CO., SAGINAW, MICHIGAN, New York City.
LUFKIN FOR DURABILITY

Look to the Future
when selecting machines



Extra "dividends" can be realized by selecting machines that have a long productive life, simplified operation, accuracy and versatility.

These "dividends" show up in the many new machines recently added to the Brown & Sharpe line, as in the No. 5 Cutter and Tool Grinder shown at the left.

Many unique features developed to meet new conditions, and long trouble-free service life combine to make a profitable investment of Brown and Sharpe

Milling Machines
Grinding Machines
Screw Machines

BROWN & SHARPE MFG. CO.
PROVIDENCE 1, R. I., U. S. A.

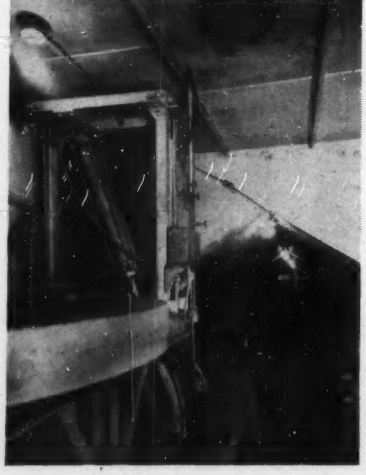
BROWN & SHARPE

Streamlining the Foundry

(*Continued from page* 13)

also improved considerably. At one time, all "shaking out" was done by hand on the foundry floor. This was not only a dirty operation, but it was also extremely slow and costly, requiring a large floor space, and involving much sand handling.

In the cooling hood, the tunnel at the right of this picture, is a mold conveyor approaching the automatic mold dump.



A good example of a modern shakeout installation is afforded by the automatic shakeout unit which operates in the following manner. After the molds have been poured, (in the flask), they are carried to the shakeout unit on a power conveyor. As the mold enters the machine, it passes over an opening which allows the bottom board to drop from the flask, with the sand and the casting following it. The bottom board is caught by a special track, and returned to the molder by roller conveyor where he uses it again. The casting strikes an inclined, vibrating grill-work which carries it down and out through an opening at the side of the machine, where it drops into a skid. The moulding sand passes through both the track and the grillwork and drops on a power conveyor which returns it to the sand reconditioning unit. The empty flask continues through the machine, and also returns to the molders via a roller conveyor. This large capacity unit operates with only two men attending it.

One man operates this push-button conveyor control and generally supervises. The second man coordinates "skid" removal, keeps a production record, and attends to other miscellaneous duties. In an 8 hour day, this two-man unit can "shakeout" and load 16 tons of castings.

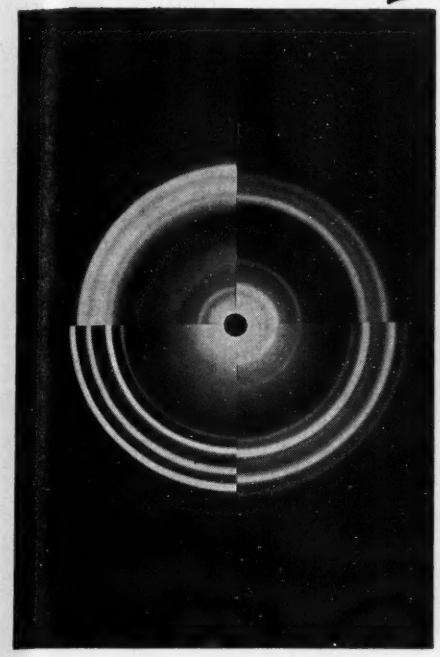
This automatic installation, when coupled with "Cope and drag" molding equipment, forms a low-cost, large-volume production unit which will soon return its original equipment investment.

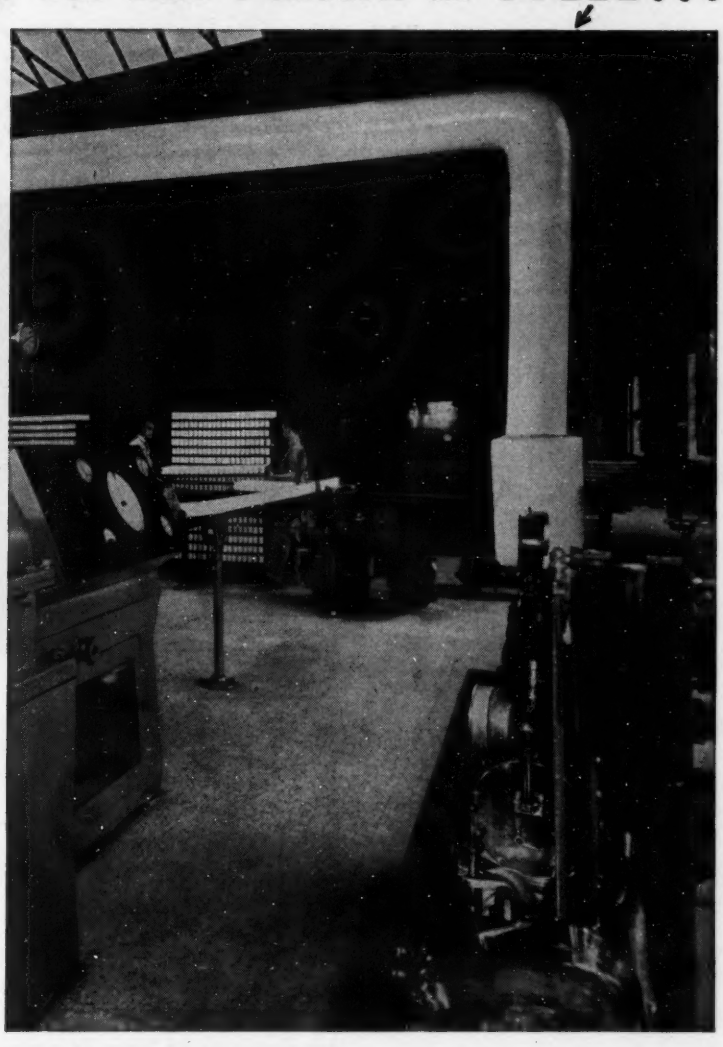
(4) *Dielectric Core Baking*

One of the most recent developments in the foundry industry is the baking of cores by high-freqency dielectric heating. Since dielectric heating can be applied to any material which is an electrical non-conductor, this method is applicable to the baking of the core-sand mixture. The method consists primarily of passing the cores

(*Concluded on page* 36)

PATTERNS in Soap set this Pattern in STEEL...





Chemists and Engineers Team-Up for Progress at P AND G

Here's an example of research that led to the engineering development of a new factory process.

The properties of a finished bar of soap depend on the polymorphic form or forms in which the soap molecules have crystallized. For instance, the comparison of the x-ray diffraction powder diagrams to the left illustrates that one soap can be prepared in at least four different polymorphic forms or phases. These different forms vary in physical properties such as plasticity, rate of solution in water, and ease of lathering.

Thus, to make a bar of soap with desirable properties, it is necessary to control both the phase composition and the chemical composition of the final product.

Research findings of this kind at Procter & Gamble are translated into designs for large-scale factory processes. The picture at the right shows a new type of factory process in which conditions are controlled to produce bars of soap of the desired crystalline form or phase.

Design, development and construction of this mechanical equipment called for close cooperation between chemists and engineers—scientific teamwork that sets a pattern for progress.

PROCTER & GAMBLE

Cincinnati 17, Ohio

partners in creating

K & E drafting instruments, equipment and materials have been partners of leading engineers for 80 years in shaping the modern world. So extensively are these products used by successful men, it is self-evident that K & E has played a part in the completion of nearly every American engineering project of any magnitude.

KEUFFEL & ESSER CO.
EST. 1867
NEW YORK • HOBOKEN, N. J.
Chicago • St. Louis • Detroit
San Francisco • Los Angeles • Montreal

Streamlining the Foundry

(*Continued from page* 34)

through an alternating, high frequency, high voltage, electric field by using a power conveyor. The exposure time may be regulated by conveyor speed, to insure thorough baking for varying section thicknesses.

This method is a very rapid one giving consistent baking conditions which are easily controlled. At present the initial equipment and installation cost is preventing a more widespread use of the process. Many foundries, however, have converted from gas oven baking because of the many advantages of the dielectric method, particularly in high production.

Because of the space limitations, and the scope of the subject matter, this discussion has been necessarily general and concerned with only a few of the many improvements in foundry layout and equipment. The foundry industry has at last come of age. On our engineers and designers lies the responsibility for its long and productive future.

LAVA

Manufacturers of Super-Refractories Only

◆

REFRACTORY CRUCIBLES
GRAPHITE CRUCIBLES
HIGH-TEMPERATURE CEMENTS
SPECIAL REFRACTORY BRICK, TILE, SHAPES

◆

From the Following Materials:—

GRAPHITE **SILICON CARBIDE** **FUSED ALUMINA** **MULLITE**
MAGNESIA **ZIRCON**

◆

LAVA CRUCIBLE COMPANY of PITTSBURGH
Pittburgh, Pennsylvania

The Miracle

you put on your eggs...

Just plain Salt! But what wonders it performs in the hands of expert chemists and engineers. Its two components play a big part in the production of paper, soap, glue, metals, metal products, textiles, insecticides. They help to sanitize water, launder clothing, kill bacteria in dairies, restaurants, food plants.

"Miracle-working" with Salt—as well as other basic chemicals—has been Pennsalt's business for 98 years. Starting with a modest plant at Natrona, Pa., Pennsalt has steadily grown, until today it stands as one of America's important chemical companies.

Big? Yes . . . but not so big as to swallow up its promising young men. Old? Yes . . . but not too old to adopt young ideas that are sound. Pennsalt was founded by a young man; and grew large through the efforts of young men.

The future, too, looks bright for Pennsalt . . . and for the young men who are going to build it. Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa.

PENN SALT

CHEMICALS

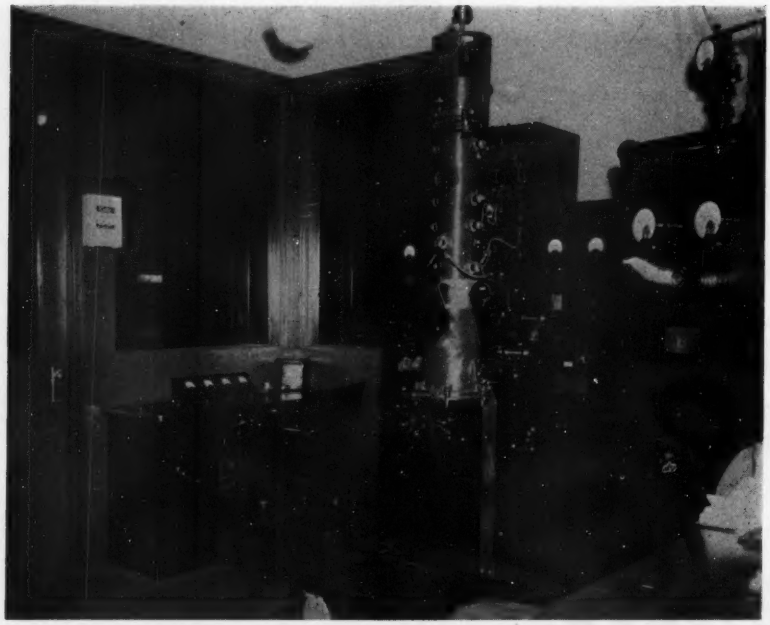
High Voltage Lab

(*Continued from page* 16)

of these units was taken out of the building before the smoke density became so serious that people were ordered from the building.

This action proved to be none too soon, for immediately the corrugated sheeting comprising the side walls of the building became loosened and pieces up to twelve feet long began to fall to the ground. These sheets, falling from heights of fifty feet, presented an obstacle worthy of respect since they were capable of causing serious personal injury.

An inside view of the High Voltage Research Laboratory prior to its destruction showing cathode oscillograph and controls for making high voltage impulse tests.



I-Beams Twisted

Falling embers from the main structure as well as those from the wooden office structure set fire to the electrical machinery, which included generators and oil filled transformers. Together these developed sufficient heat to cause structural failure of the building. Twelve-inch I-beams which comprised the vertical girders were twisted until all building members sagged into a heap. The ten-ton crane was gently lowered to a position almost touching the floor.

As the fire progressed three large transformers, each containing fifteen hundred and thirty gallons of oil, were set on fire. One of these transformers was supported approximately five feet above the laboratory floor, and the other approximately ten feet on resin impregnated paper tubes. These transformers weighed almost fifteen tons

(*Concluded on page* 44)

A GOOD NAME TO CALL ON

NATIONAL ELECTRIC PRODUCTS

WIRING SYSTEMS

WIRES AND CABLES

➡ FOR WIRES AND CABLE

➡ FOR RACEWAYS AND FITTINGS

THE WORLD'S LARGEST PRODUCER OF ELECTRICAL ROUGHING-IN MATERIALS

National Electric Products Corporation

Pittsburgh 30, Pa.

SIGNS OF SPRING

About this time of year, the early birds visit the Athletic department to watch us unpack the new sports equipment for Spring. They try on the baseball gloves, juggle the softballs and swing the tennis rackets, thinking with pleasure of all the Spring and Summer sports which will be with us soon.

This year, we'll have golf clubs too and the usual supply of Jantze nswim and sun clothes. If you need sports equipment or clothing, better shop at the Co-op for prices are usually a little lower and you get that 10% dividend too.

Come in and swing a few rackets yourself.

◇

THE CORNELL CO-OP

BARNES HALL — ON THE CAMPUS

DU PONT Digest
For Students of Science and Engineering

Experimental research results in better Vitamin D source for poultry industry

Fifteen years of work by Du Pont chemists, biochemists, physicists, and engineers behind development of "DELSTEROL"

In 1922, it was shown that vitamin D controls the utilization of calcium and phosphorus in the body, especially in the bones of growing animals. This led to the discovery that leg weakness in chicks, poor production, low hatchability of eggs, and other disturbances were caused by a deficiency of this vitamin.

L. Fullhart, Ph.D. 1946 in organic chemistry, Iowa State College and W. F. Marlow, chemist, B.S. 1941, George Washington University, preparing to examine a sterol product for quality and yield.

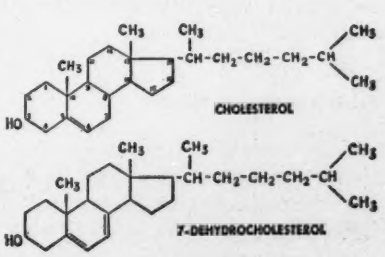
Scientists subsequently discovered that vitamin D could be made by irradiating plant or animal tissues with ultraviolet light. This reaction has since been shown to consist of transforming certain provitamins from the group known as sterols, into vitamin D. The final result of these discoveries was the present large-scale commercial production of the vitamin by a series of complex chemical and photo-chemical reactions which require careful control by chemists, biochemists, physicists, and engineers. In this development, Du Pont scientists played an important part.

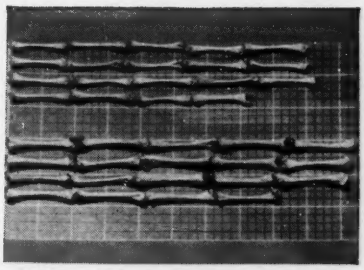
Ergosterol once the only source

For years before 1934 it was assumed that ergosterol, a sterol first isolated from vegetable sources, was the only provitamin that yielded vitamin D. In that year, Du Pont research men—who had been studying the chemistry and biochemistry of vitamin D for almost four years—announced that the provitamin in animal cholesterol was *not* ergosterol. They showed that the activated provitamin in cholesterol gave a vitamin D much more effective for chicks than that of irradiated ergosterol. This fact was based on many comparative assays of irradiated cholesterol, irradiated ergosterol, and irradiated mixtures of these substances on rats and chicks.

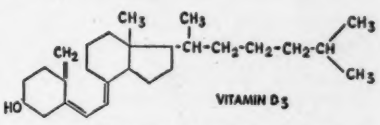
Synthesis from Cholesterol developed

Other investigators showed that the provitamin in cholesterol was 7-dehydrocholesterol by developing its synthesis from cholesterol. The relationship between cholesterol, 7-dehydrocholesterol, and vitamin D_3 is shown by the following formulas:





Bones at top, from birds fed no vitamin D, are shorter, poorly developed, and fragile, compared with bones at bottom from birds fed Du Pont "Delsterol."



Du Pont chemists and engineers carried this forward by devising a successful commercial process for making 7-dehydrocholesterol and irradiating it to vitamin D_3. Several forms of vitamin D are now manufactured by Du Pont, ranging from oil and dry powder concentrates—used by the poultry trade under the trademark "Delsterol"—to vitamin D_3 crystals of the highest purity.

Today's chickens are healthier, and the average annual egg yield over the last eight years has increased from 134 to 159 per bird. To a considerable degree, this is a result of the fifteen years of research devoted by Du Pont scientists to the development of "Delsterol" "D"-activated animal sterol.

Questions College Men ask about working with Du Pont

What are the opportunities in sales?

Separate sales staffs are maintained by each of Du Pont's ten manufacturing departments. Training in chemistry or chemical engineering is a prerequisite for some sales positions, which may be in one of three fields: technical sales, sales development, or direct selling. New employees usually acquire technical background by first working in a control laboratory or in production. Write for booklet, "The Du Pont Company and the College Graduate," 2518 Nemours Building, Wilmington 98, Delaware.

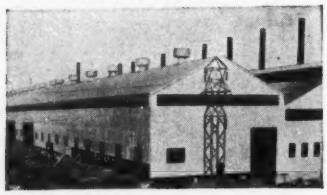
DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

More facts about Du Pont — Listen to "Cavalcade of America," Mondays, 8 P.M., EST on NBC

TIME
PROVES
Galvanized (ZINC-COATED) Sheets
Stay Stronger Longer

34 YEARS . . . Erected in 1913, and covered with heavy-gauge galvanized sheets, this Tennessee concentrating plant of the A/Z Company, is still in excellent condition after *more than 3 decades of service.* Painted with Gray Metallic Zinc Paint in 1932.



In building for the future, look to the past for proof of a building material's strength . . . durability . . . service. With galvanized (zinc-coated) roofing and siding, you get the strength of steel . . . the rust protection of Zinc. So for low-cost, long-time service, choose the building material that's proved by TIME itself . . . galvanized sheets. Send coupon for information about Zinc and how it can help keep your buildings and equipment stronger longer.

ZINC INSTITUTE 2 OZ. COATING SEAL OF QUALITY

This "Seal of Quality" is your guide to economy in buying galvanized sheets. It means they carry at least 2 oz. of Zinc per sq. ft.

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FREE BOOKLETS!

Send me without cost or obligation the illustrated booklets I have checked.

- ☐ Repair Manual on Galvanized Roofing and Siding
- ☐ Facts about Galvanized Sheets
- ☐ Use of Metallic Zinc Paint to Protect Metal Surfaces

Name_____

Address_____

Town_____ State_____

The Literate Doll

(*Continued from page* 15)

carried out in three dimensions, since the machine must make a two-dimensional drawing and also lift the pen off the paper quite often. Thus three directional components must be provided to move the writing arm of the automaton.

By far the most convenient method of satisfying these requirements is to use a set of three metal disk cams, and both the Maillardet and Jacquet-Droz automatons employ this basic unit. The arm joints have the same play as those of a human arm, except that the wrist does not bend. Appropriate systems of levers transmit motion from the cam followers to the arm. The basic difference between the Jacquet-Droz and Maillardet machines is approximately that which exists between a typewriter and a printing press; that the former will write any combination of letters while the latter will only produce the several phrases and pictures for which it has been set up. The Jacquet-Droz writer worked as it did because it had a set of three cams for each letter of the alphabet, plus a large indexing wheel which could be set beforehand to bring the cams into play in the proper order for writing a sentence, which could be forty letters long. Maillardet's automaton is simpler in principle, for it has much larger cams of which three or four sets of three are needed to do one piece of work. This allows the machine not only to write but to make drawings as well, but its repertoire cannot be changed without replacing the cams. Its accuracy and fineness of work is not as great as that of Jacquet-Droz's writer which utilized a trio of cams to supply the entire motion for each letter, but it can write verses, make capital letters, and draw borders around its work, besides making pictures.

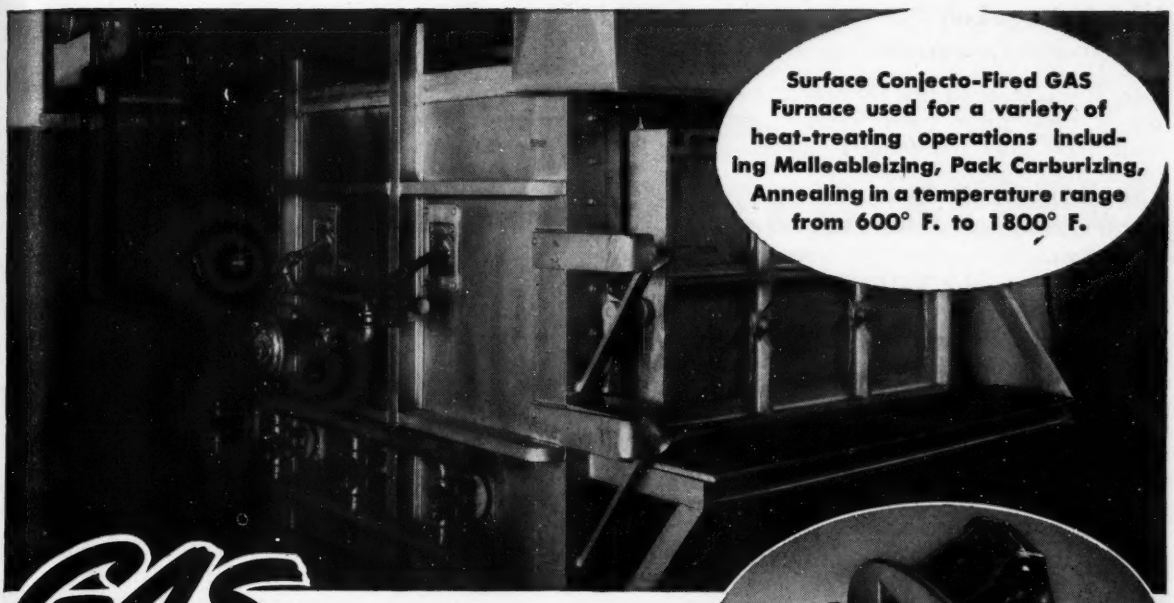
Principle of Operation

An examination of the illustration on page fifteen shows fairly well the main parts of the mechanism and the principle of its operation. Very prominent in the center of the picture are the cams, the "brain" of the automaton. It is easy to see that the cams are divided into three groups, the cams in each group connected together by horizontal bars on which the cam followers are resting. The two groups on the left produce vertical and horizontal motion on the drawing, while the right group takes the pen on and off the paper. Each disk in a group has a mate in each of the other two groups with which it always operates simultaneously. The arrangement is economical of space, since it allows the whole repertoire to be covered by moving the set of cams only one-third of its length.

Indexing the cams is done by a large drum fitted with a single helical rib, which is just visible at the extreme upper left corner of the apparatus. The drum is rotated by a strong spring motor, and on its end, which is visible on the side of the case, are engraved the titles of the various drawings and verses, so that the operator can set the drum to any desired position. Each drawing requires several sets of cams for its execution, and at the end of each revolution the cams stop with the followers resting on the transverse bars. They remain undisturbed as the indexing drum automatically slides the next set of cams into alignment, so that the work can continue. The time spent in this operation is utilized to advantage, for the doll raises her pen, straightens up, and looks critically at her paper, as if deciding what to draw or write next.

There were no electric motors available when Maillardet built his automaton, but he was quite successful in constructing spring motors powerful enough to operate the mechanism smoothly. The motions of the cam followers are multiplied several times to produce the movements of the pen, so that considerable torque is required to rotate the cams. Yet the spring motor on the right side of the mechanism operates very smoothly, as does the one on the left which turns the indexing drum.

Certainly great credit is due Maillardet, who, with the technology of 150 years ago, constructed such an ingenious, lifelike, and durable machine.



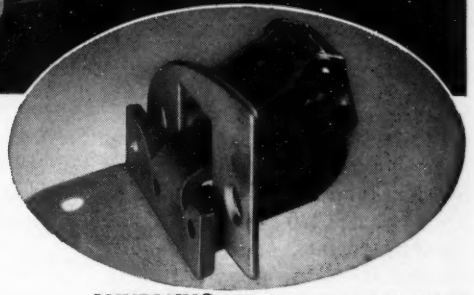
Surface Conjecto-Fired GAS Furnace used for a variety of heat-treating operations including Malleableizing, Pack Carburizing, Annealing in a temperature range from 600° F. to 1800° F.

GAS FURNACE PERFORMS MULTIPLE HEAT-TREATING FUNCTIONS UNDER VARIED CONDITIONS

In modern heat-treating, adaptability of equipment and flexibility of fuel are primary influences in any cost-per-piece analysis. As a typical example of the flexibility of the productive flames of GAS, this Conjecto-Fired GAS Furnace is used for a variety of operations without any change other than regulation of the fuel-mix and temperature controls.

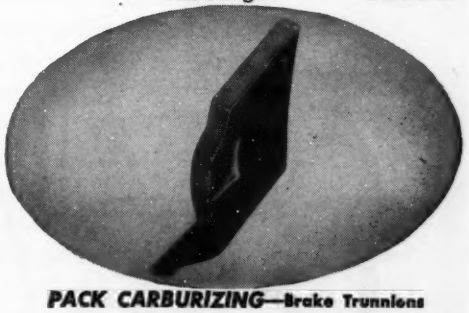
Atwood Vacuum Machine Company, Rockford, Illinois, is equipped to heat-treat pieces ranging from 1 ounce to 1000 pounds, in volume up to 15,000 pounds daily. Their modern Gas-fired Equipment is adapted for annealing, carburizing, drawing, hardening, normalizing, malleableizing, stress relieving, under rigid metallurgical specifications.

Experienced heat-treating specialists like Atwood Vacuum Machine Company use GAS because this flexible, controllable, rapid-heating fuel is so readily adaptable to all types of processing at any required temperature. The productive flames of GAS are so flexible that they can be used for any production-line heating operation, under the most exacting conditions.



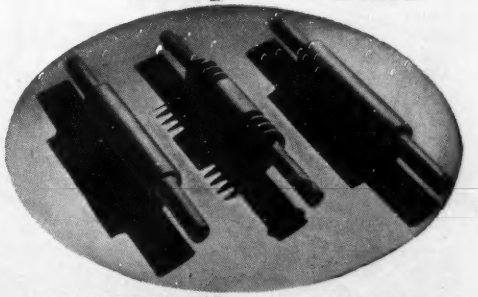
ANNEALING—Station wagon body hinge

Material:	SAE 1020
Temperature:	1600° F.
Time Cycle:	36 hours
Net charge:	6400 lbs.



PACK CARBURIZING—Brake Trunnions

Material:	Hot rolled SAE 1010
Temperature:	1650° F.
Time Cycle:	8 hours
Case:	.040
Net charge:	1500 lbs.



MALLEABLEIZING—Trailer Jack Screws

Material:	Malleable Iron
Temperature:	1750° F.
Time Cycle:	72 hours
Net charge:	10,000 lbs.

AMERICAN GAS ASSOCIATION

420 LEXINGTON AVENUE • NEW YORK 17, NEW YORK

Data and Photos by SURFACE COMBUSTION CORPORATION, Toledo, Ohio, Manufacturers of Gas Heat-Treating equipment

MORE AND MORE... THE TREND IS TO GAS

High Voltage Lab

(*Continued from page* 40)

each. It was expected that the failure of these paper tubes would cause these huge transformers to topple over. Failure, however, occurred gradually and the two supported transformers settled gently to the floor.

Equipment in this building included special high voltage equipment capable of generating lightning surges of three million volts. Instrumentation capable of measuring the voltage, current and time relationships existing in standard artificial lightning test circuits furnished valuable information for high voltage apparatus development.

The transformers mentioned above permitted testing at 60 cycle voltages of 430,000 volts 3 phase, and of 750,000 volts single phase. There were innumerable smaller machines including Diesel driven three phase 220 volt generators, gasoline engines, large alternators up to 1000 KVA rating, and many items to be used in connection with high power and high voltage testing.

A complete machine shop, dark room, and control room containing expensive control equipment were wrecked. Research instrumentation, office records and furniture, substation and heating plants were ruined.

Loss Estimated At Million

The loss initially estimated at a million dollars is to a great extent irreplaceable.

The laboratory, built as a cooperative enterprise by industry and the University, was intended for research and instruction. Those industrial concerns contributing toward the erection of this laboratory saw in this project a unique possibility for industrial cooperation and an opportunity to advance study in the realm of high voltage phenomena.

The total destruction of the laboratory and all its contents has been a severe loss to the University. Extremely gratifying has been the attitude of the friends of Cornell, alumni, students and industrial organizations. All have recognized the value of the laboratory, and have with their expressions of sympathy sent inspiring messages to have it rebuilt. Communications from Binghamton to Bagdad have expressed a desire to have the research continued. From industry have already come many offers to assist in rebuilding.

Much experience has been acquired during the existence of this laboratory which could be profitably used for the reconstruction of a new edifice.

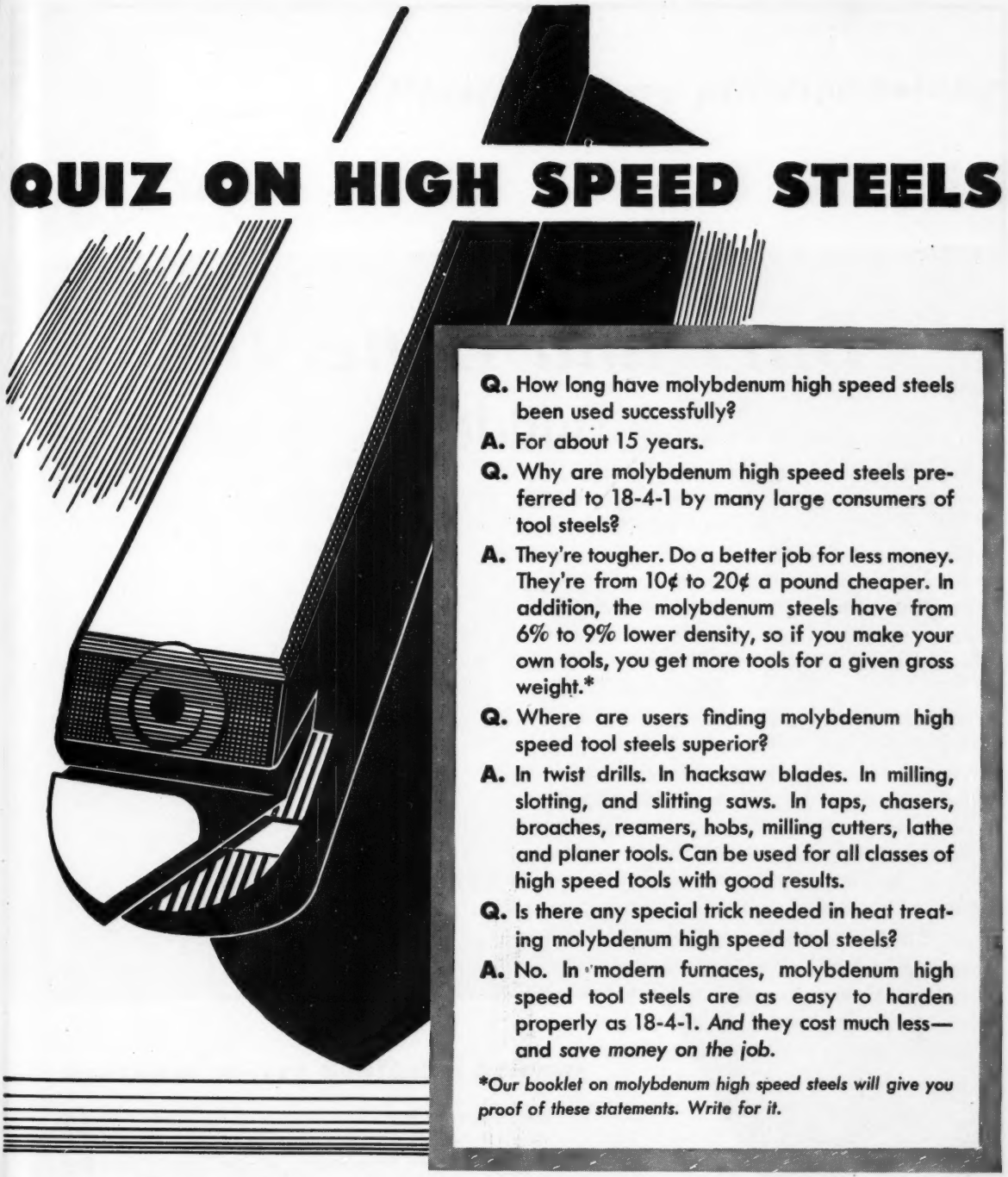
Cornell's High Voltage Research Laboratory was an engineering project comprising unusual facilities, the combination of which were unequalled throughout the world. It is the hope of those interested that this may even be excelled in a new High Voltage Laboratory.

CORRECTION:

Author of the "Profile" of Dr. Hans A. Bethe, CORNELL ENGINEER, March, 1948, was most regretably printed in error. The article was written by JOHN H. GAY, EP '51.

TWO SUCCESS STORIES with the same reason
Just as the leather football helmet is a continuing success on today's gridiron, leather power-transmission belting is a continuing success in today's industry.
The reason: Both take advantage of the natural characteristics of leather.
Leather is a live, dynamic, resilient material. It has shock-absorbing ability, great strength and long life. That's why leather belting is an efficient, modern drive.
NEWS NOTE
The National Football League's governing body recently barred the use of plastic helmets in league play because of the increased possibilities of serious injury from contact with the hard surface of the headgear. This means that leather helmets will continue to be the standard head protection for American football teams.
Al-12
American LEATHER BELTING Association
Headquarters for Authentic Power Transmission Data
41 PARK ROW, NEW YORK 7, NEW YORK

QUIZ ON HIGH SPEED STEELS



Q. How long have molybdenum high speed steels been used successfully?

A. For about 15 years.

Q. Why are molybdenum high speed steels preferred to 18-4-1 by many large consumers of tool steels?

A. They're tougher. Do a better job for less money. They're from 10¢ to 20¢ a pound cheaper. In addition, the molybdenum steels have from 6% to 9% lower density, so if you make your own tools, you get more tools for a given gross weight.*

Q. Where are users finding molybdenum high speed tool steels superior?

A. In twist drills. In hacksaw blades. In milling, slotting, and slitting saws. In taps, chasers, broaches, reamers, hobs, milling cutters, lathe and planer tools. Can be used for all classes of high speed tools with good results.

Q. Is there any special trick needed in heat treating molybdenum high speed tool steels?

A. No. In modern furnaces, molybdenum high speed tool steels are as easy to harden properly as 18-4-1. *And* they cost much less—and *save money on the job.*

**Our booklet on molybdenum high speed steels will give you proof of these statements. Write for it.*

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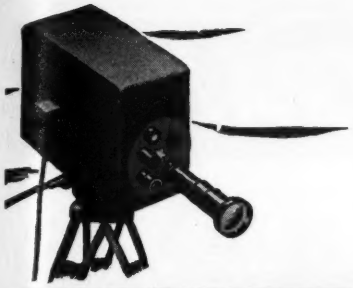

Plastics where plastics belong

Synthane where Synthane belongs

HERE's Synthane at work in a channel selector turret . . . the nerve-center of any television receiver. Synthane is employed for a number of the intricate parts to insure extreme electrical and mechanical precision and rugged operation. It's an appropriate job for useful, hard-working Synthane . . . a timely example of plastics where plastics belong.

In addition, Synthane is moisture and corrosion resistant, hard, dense, easy to machine, and has unusual electrical insulating qualities. Synthane is also structurally strong, light in weight and stable over wide variations in temperature.

These and many other properties—combined—make Synthane adaptable to countless chemical, electrical and mechanical applications. Synthane Corporation, 14 River Road, Oaks, Pa.

SYNTHANE

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STRESS and STRAIN...

Two men were working on the White House lawn, each supplied with a small push cart upon which was a garbage can. They walked along picking up papers with a long spear. One spied a piece of toilet paper and started to spear it, when suddenly a gust of wind came up and blew the paper into the White House through an open window.

The man became frantic and rushed into the building. He returned shortly afterwards and said, "I was too late. He had already signed it."

* * *

Howie Golub, widely publicized instructor in the Lincoln School of Civil Engineering, says that after taking English for the eighth time he has finally discovered the name of King Lear's brother . . . Chandelier.

* * *

"Do you neck?"

"That's my business!"

"Oh, good! A professional."

* * *

What did one bug say to another bug when the latter smashed against the automobile windshield?

"I bet you don't have the guts to do that again."

* * *

She's stopping at the mountain house
But great seclusion seeks
She always dresses in the dark
Because the mountain peaks.

* * *

Then there was the overworked E.E. who told the story about the politically minded ion who heard there was going to be an electron so he went to the poles and volted.

"Did she blush when her shoulder strap broke?"

"I didn't notice."

* * *

Two mosquitoes once lit on the features
Of two fair and peroxided creatures.
When asked by what right,
They replied, "We're not tight,
We're just seeing the game from the bleachers."

* * *

Frosh: How do you manage to keep drinking the coffee in the Straight?

Senior: I take a spoonful of Drano every week.

* * *

In the quiet of a dark cloudy night, two safe robbers were preparing to open the safe of a bank in a small town.

One of the robbers started to turn the dial of the safe with his toes.

"What's the matter with you? Let's open this thing and get out of here," said his partner.

"Naw, it'll only take a minute longer this way," replied the first, "and we'll drive them fingerprint experts nuts."

* * *

A drunk staggered into the Stork Club one night and in a loud voice yelled, "When I drink everybody drinks?" He summoned everyone to the bar. And they called the musicians, the hatcheck girls and the guests to the bar. Everybody took a drink. When he finished the whiskey, he yelled again "When I take another drink, everybody takes another drink." When he finished that one, the drunk took a dollar out of his pocket and slapped it on the bar. "When I pay," he screamed, "everybody pays."

A Scotchman walked up to a friend at the bar and began telling him about a hunting trip. "We shot a couple of bears," he said, "but the biggest thrill was tracking yures."

"What's yures?" asked the friend.

"I'll have a beer, thanks," replied the Scotchman.

Just as they reached the bottom of their glasses, the friend remarked, "Well, I'll have to be going. Got to get home and do my chores."

"What chores?" asked the Scotchman.

"Beer, please," said the other.

* * *

He: "Wish we had a fifth for bridge."

She: "You don't need a fifth for bridge."

He: "O.K. make it a pint."

* * *

There was a young lady from Lynn
Who thought that to love was a sin,
But when she was tight
It seemed quite all right,
So everyone filled her with gin.

* * *

A Kansas preacher at the close of a sermon discovered one of his deacons asleep. He said, "We will now have a few minutes of prayer. Deacon Brown, will you open?" Deacon Brown roused a bit and sleepily replied, "Open, hell, I just dealt."

* * *

With graceful feet, a maiden sweet
was tripping the light fantastic;
When she suddenly tore for the dressing room door
Saying, "Darn this post-war elastic."